ELECTRONICS Australia

April, 1970

40¢

Expansion of Belgium's telecommunications network

SIMPLE ALL-WAVE RECEIVER • ELECTRONIC BONGO DRUMS

144MHz CONVERTER • MONITOR PREDICTS HEART ATTACKS

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PREDICTING HEART ATTACKS: *Medical electronics technology, which has already done so much to assist in the diagnosis and treatment of disease, has gone a step further with the introduction of a heart-beat monitor to predict heart attacks. (Page 8.)*

OUTBACK COMMUNICATIONS: *The Post Office is conducting experiments to ascertain whether it is feasible to use satellites to provide people living in remote areas of Australia with telephones. (Page 20.)*

INTERNATIONAL STANDARDS: *Australia is to convert its system of weights and measures to the metric system. There is more to this than metres and grams, as our article shows. (Page 40.)*

144MHz AMATEUR CONVERTER: Readers active in amateur radio should be very interested to see our new design for a fully solid-state 144MHz converter, using MOSFET devices. (Page 68.)

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CONTENTS — APRIL, 1970

features

technical digest

technical articles

regular features

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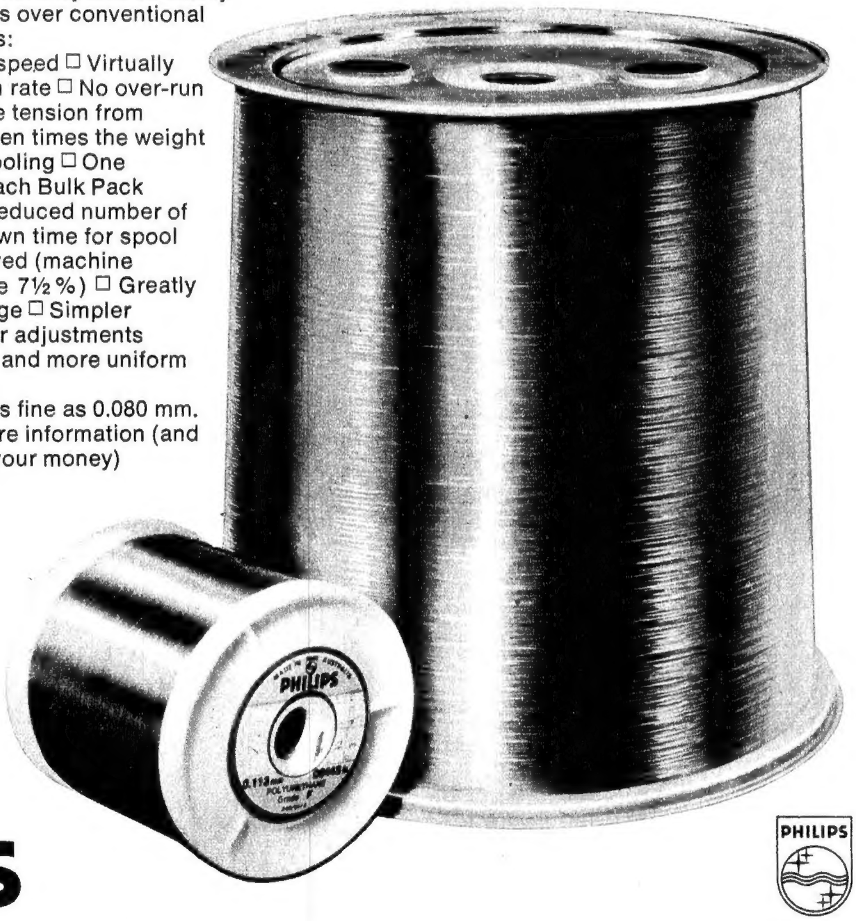

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EDITORIAL VIEWPOINT
by Neville Williams

We'd like to help, but . . .

From time to time, readers ask us to recommend a line-up of audio equipment to suit their particular needs. Some want "only the best"; others nominate a limit price. Some are interested in high power, or a lot of facilities; others are not.

Because such readers are trying to resolve a genuine problem, the natural urge is to offer assistance but, for very practical reasons, we have to refuse as graciously as we can.

Among these "practical reasons" is the sheer impossibility of coping individually with problems flowing from more than 100,000 readers. Inevitably, too, we would become involved, as a third party, in disputed transactions: "You recommended so-and-so, but . . . ."

There is the question of bias. Our whole operation depends on providing an impartial medium for those who wish to sell and to buy, to explain and to read about legitimate electronic products and techniques. To express preferences between genuinely competitive products would be to invite hostile reactions from the slighted parties.

These difficulties aside, however, nobody could possibly make a fully informed recommendation without, at all times, knowing the range of audio components available to the inquirer (whether in Australia or New Zealand), their actual performance and reliability (not just specifications), the price at which they are actually being offered, and the ability of the vendor to provide after-sales service. Those with a penchant for permutations and combinations might like to envisage the number of tape recorder makes and models, which might be on sale anywhere in the two countries, the number of cartridges, arms and turntables, of amplifiers and loudspeakers — and the number of suppliers and their service facilities. Add, if you like, and for good measure, possible questions about compatability.

We freely admit to not having all this information on file. What is more, we know of no-one who has!

In the absence of a sage who knows all the answers, the best way to select audio equipment is still the hard way: Read all the advertisements; prowl around the showrooms; talk to people who already have audio equipment; listen to all the "advice" but keep your options open. You will be confused at first but, gradually, a pattern will emerge — relating what is available to what you can afford. If you can cope with installation problems, the components can be bought individually; if you can't, buy the whole system from one supplier.

One important factor will be working for you: No one combination of equipment has the monopoly of musical pleasure. If you buy reputable equipment from a reputable source, the chances are that you'll be very happy with it, brands notwithstanding.

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On the cover

The Philips Company, in Holland, made a major contribution to the telecommunications system of the neighbouring country of Belgium. Recently, the company supplied terminal and repeater equipment for a 2,700-channel coaxial cable linking the capital, Brussels, and important industrial centres of Antwerp, Ghent and Namur. Our cover picture shows an underground repeater box being installed on a coaxial cable route near Antwerp.

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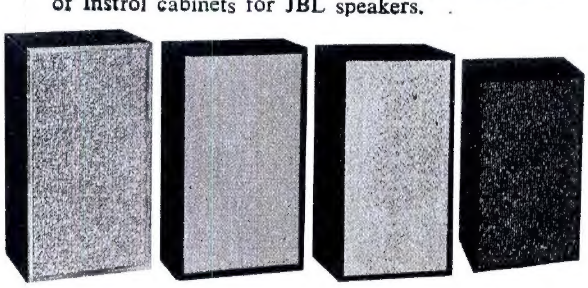

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Power handling capacity 60 watts RMS.
Impedence 8-16 ohms.

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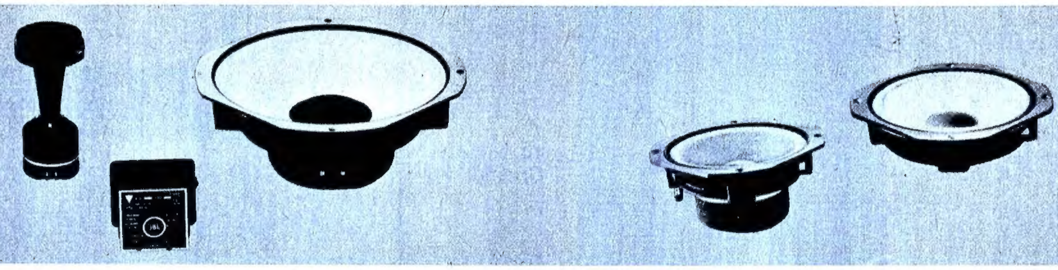

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Like all JBL Electronic products, the SA660 is designed and manufactured by JBL personnel in JBL's own electronic facilities.

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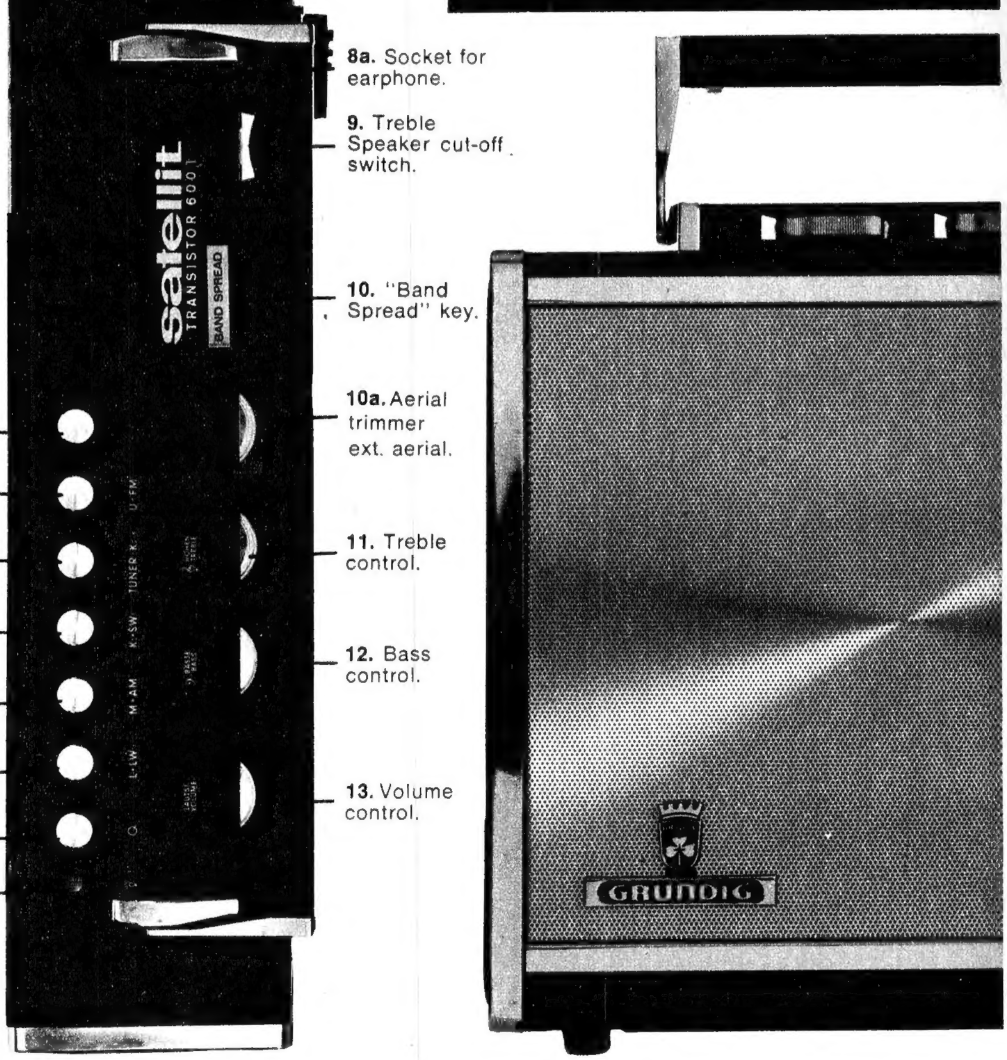
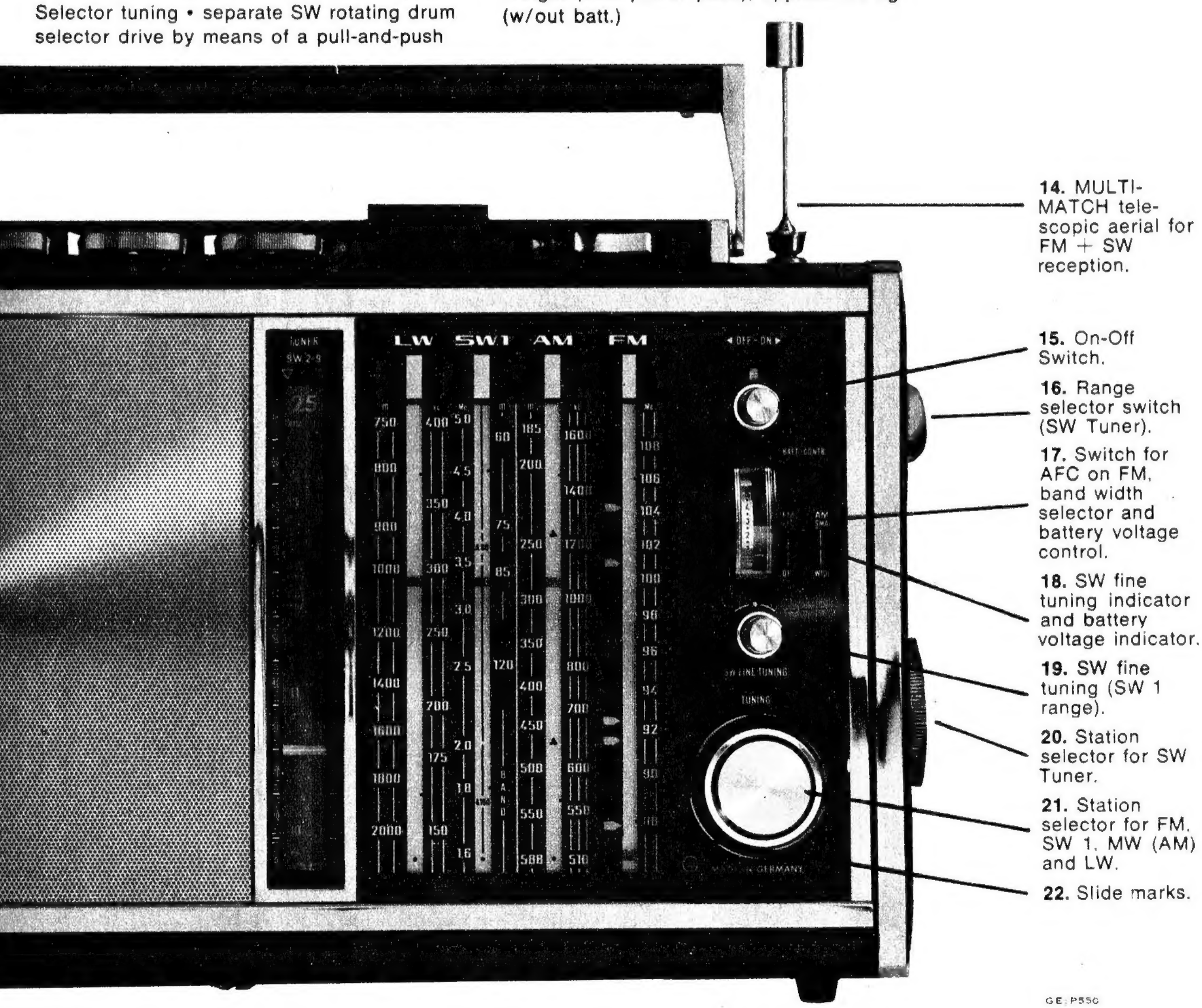


Grundig Transistor 6001

Technical Specifications:

20 tuning ranges: FM, 17 x SW (SW 1: 60-187 m, SW 2: 42-60 m and 49 m band, SW 3: 36-50 m and 41 m band, SW 4: 26,5-37 m and 31 m band, SW 5: 21,5-30 m and 25 m band, SW 6: 16,5-24 m and 19 m band, SW 7: 14-20 m and 16 m band, SW 8: 12-16,7 m and 13 m band, SW 9: 10-14 m and 11 m band), Medium Wave (AM) and Long Wave • circuits: FM 14 (3 can be tuned), AM (without SW Tuner) 9 (3 can be tuned); SW Tuner 14 (3 can be tuned) • 19 + 1 transistors (17 of these are silicon trans) • best possible cross modulation by field effect transistors • 14 + 2 diodes • tuned-in first stage on all ranges • double superimposition of SW Tuner with 4-circuit band filter • gain control: AM 3-stage, SW Tuner 3-stage with additional control, FM 1-stage • ferrite aerial for MW (AM) and LW; MULTI-MATCH telescopic aerial for FM and SW (switchable) • DUPLEX Single Selector tuning • separate SW rotating drum selector drive by means of a pull-and-push tuning knob • colour marks for station tracing • SW fine tuning for SW 1 • "Band Spread" key • switchable AFC on FM • AM band width selector switch • tuning indicator (S-meter) • battery voltage indicator • 2 Superphone speakers (treble speaker can be switched off) • bass and treble control • 2 Watts push-pull output stage • battery operation by 6 x 1,5 V mono cells • built-in mains power pack TN 12 • dial scale illuminated • sockets for external power supply, earphone, external speaker, outdoor aerial, car aerial, outdoor dipole antenna, ground, record player/tape recorder • receptacles for SSB device with switch-over to manual control, sound filter, product demodulator • cabinet: wood, w/leatherette covering, in black and walnut.

Size approx. 44 x 26 x 12 cm
(= 18½" x 10¼" x 5")
Weight (incl. power pack), approx. 6.1 kg (w/out batt.)

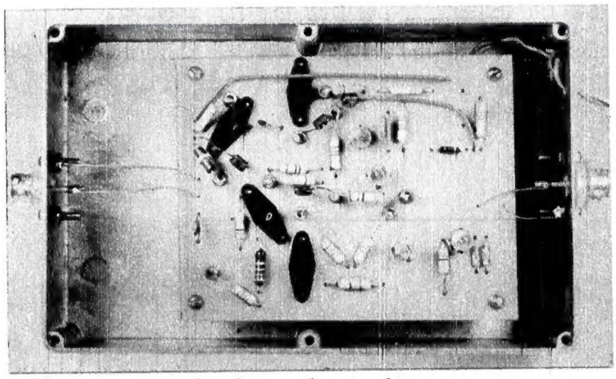


GE:P55C

A Crystal-Locked Converter for the 144MHz band, using MOSFETS

Here is an up-to-the-minute solid state VHF converter design for the two metre amateur band. Using economical MOSFET transistors, the converter has a noise performance significantly better than the best valve designs. It also offers excellent cross-modulation characteristics, a feature not normally associated with solid state circuits and devices.

by ANTHONY LEO



The photograph above shows the new converter mounted in a diecast metal box with coaxial connectors used for both input and output.

In the past, we have described a number of converters, of both the crystal-locked and tuneable variety, intended for both the two and six meter amateur bands. All of the designs have used valves in various configurations, examples being those described in the February and March issues of 1959, and in March, 1963.

At the time these designs were published, they fulfilled a significant need for reliable, simply constructed and stable VHF converters, and accordingly, they have been very popular. While the converters required only a small number of tuning adjustments they nevertheless had to be adjusted for optimum neutralisation in order to maintain stability and achieve minimum noise.

The converter to be described here uses solid state devices throughout, and also does not require neutralisation. And, typical of solid state designs, the power requirements are very modest and well suited to mobile operation. The supply requirements are for 12 volts nominal with a current drain of approximately 20 milliamps.

At this stage, it may help readers unfamiliar with VHF reception techniques if we digress to give a brief explanation of VHF converters and their use. Converters, or more correctly, frequency converters, are devices used fundamentally to extend the tuning coverage of a broadcast or short wave receiver. The tuning range of a typical short wave receiver may extend from about 3MHz to 18MHz, while the range of a more serious HF (high-frequency) communications receiver may extend to as high as 30MHz.

However, with the addition of a converter, such a receiver may be used to receive frequencies many times higher than its normal top frequency limit. The converter makes the reception of very high frequency (VHF) signals possible by simply changing or heterodyning the signal frequency down to a figure within the receiver's tuning range.

In this instance, we are interested in receiving frequencies between 144MHz and 148MHz, in what is commonly referred to as the "two metre" VHF amateur band. With the aid of the converter to be described, it is possible to receive two metre signals on any shortwave receiver covering frequencies between 3.5MHz and 7.5MHz. The converter is simply inserted between the receiving aerial and the receiver, as shown in Figure 1.

The converter itself is a broad-band device, which heterodynes all signals in the VHF band down to within the tuning range of the receiver. Selection of the desired VHF signal is carried out by adjusting the receiver tuning. Used in this way, the receiver may well be considered as a "Tuneable IF" (Intermediate Frequency) and this name is often used when a receiver is used with such a converter.

It should perhaps be pointed out that although a converter of this type may be used with a wide variety of receivers, and with satisfactory results, not all receivers are equally suitable for this method of VHF reception. This is because the requirements for VHF reception, and hence for an ideal "tuneable IF", are actually somewhat broader than those for optimum HF reception.

Hence, a receiver for the HF bands generally requires fairly narrow bandpass characteristics, together with a detector system capable of receiving CW, AM, and SSB signals. However, a tuneable IF for satisfactory VHF reception generally requires not only these facilities, but all the alternative facilities of relatively wide band width and the detector systems appropriate for reception of narrow and wide-band FM signals. In some cases the ability to receive pulse-code-modulation or "PCM" might also be necessary.

The very basic requirement for a converter is therefore that it must change the frequency of VHF signals so that they can be received by equipment operating at much lower frequencies. However, in practice there is an important further requirement, and that is that the converter should contribute as little noise as possible to the overall receiving system. Like any other device containing resistors and active devices, all converters tend to generate noise and thus degrade to some extent the signal to noise ratio of signals passing through them.

Perhaps surprisingly, it is the noise performance of a VHF converter itself which usually determines almost completely the smallest signal which can be usefully received. This is so because the man-made and other noise received by the aerial, together with the signal, is at a very low level at VHF compared with the noise received at high frequencies. This tends to make the noise contributed by the receiving system even more significant with respect

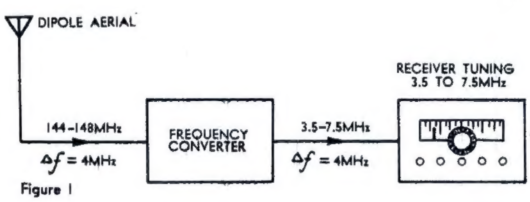


Figure 1

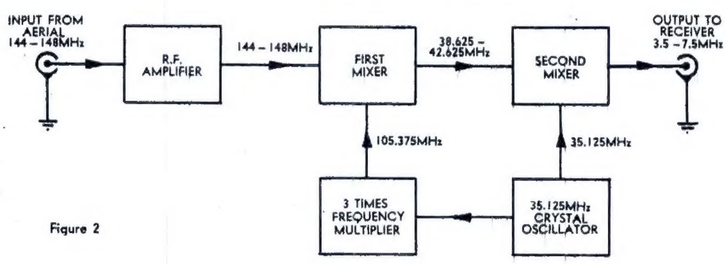


Figure 2

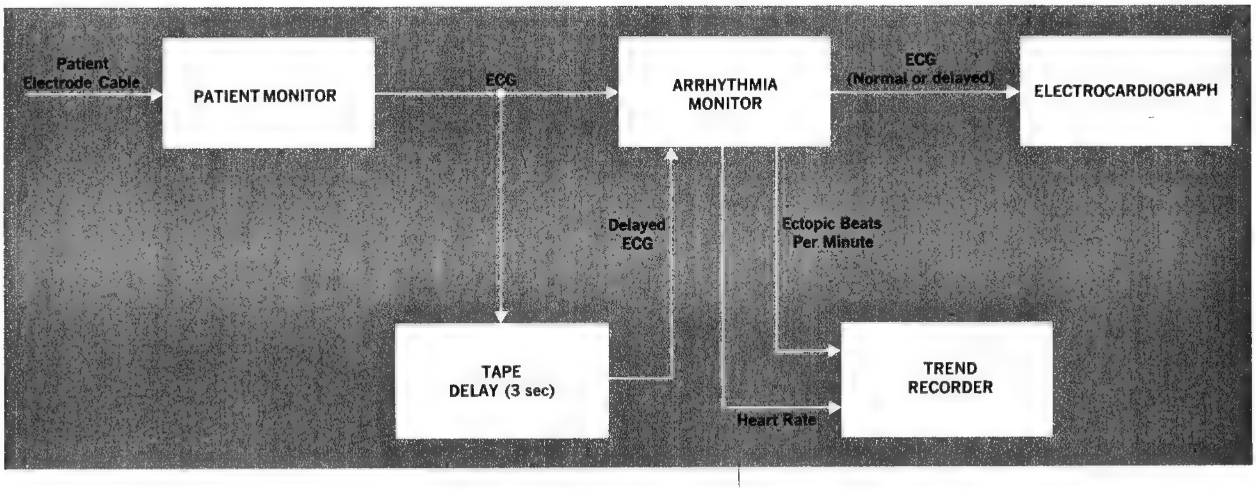


Figure 2. Block diagram for a patient monitoring system which includes an Arrhythmia Monitor and recorders for accumulating important diagnosis information about the patient's condition.

The travelling electrical impulse continues on through the atrioventricular (AV) node, a channel of specialised tissue located at the junction of the walls that separate the chambers of the heart. This tissue — which has a conduction speed of 200mm/S, about one-fifth that of the atrial walls — conducts the pacemaker pulses to the lower part of the heart. (Other paths from the upper to the lower chambers of the heart are blocked electrically by non-conductive tissue). Impulse conduction through the AV node is represented by the quiet section between the P and Q waves on the electrocardiogram.

Once past this biological delay line, the pacemaker pulse is spread rapidly over the muscle tissue in the lower part of the heart, the ventricles, by a high-speed conduction system called the "Bundle of His." The ventricles are the heart's major pumping muscles and the sum total of their muscular activity is represented on the electrocardiogram by the QRS complex, the most prominent feature of the heart-beat.

Electrical repolarisation of the ventricular muscles is represented by the T wave (figure 3).

All of the electrically active tissues in the heart are capable of self-triggering, but at rates slower than the pacemaker. If disease should block the normal conduction paths, the heart can continue to pump blood, but not as effectively as the healthy heart.

When arteries supplying blood to the heart muscles become blocked, the affected muscle suffers from lack of oxygen (ischemia) and ultimately may die (myocardil infraction). The ischemic tissue may become irritated, causing it to "trigger" on its own. If this occurs in the atria, the atrial muscles may be triggered prematurely. The rest of the heart, though, responds electrically to the premature atrial activity in a normal fashion. The ECG wave form for this condition is shown in figure 4.

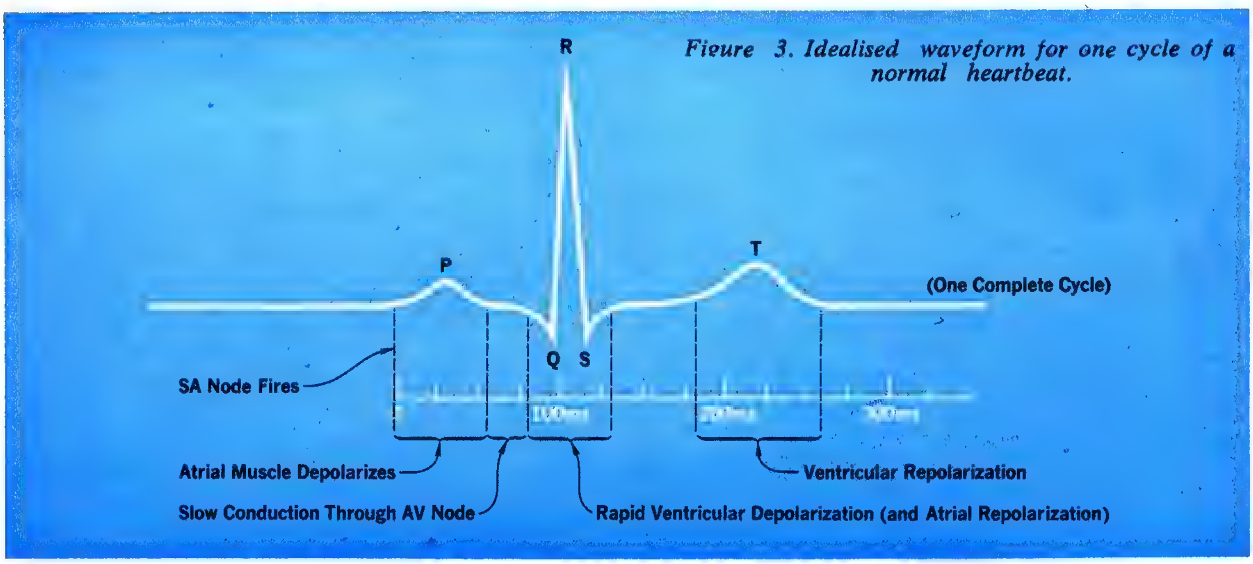
If irritation occurs in the ventricles, however, the self-triggering impulse, since it does not arrive through the AV node, travels a different and slower path in spreading over the ventricles. The QRS then becomes widened, and is classified as a ventricular ectopic beat (figure 5). (Abnormal beats are called "ectopic" by the medical profession.)

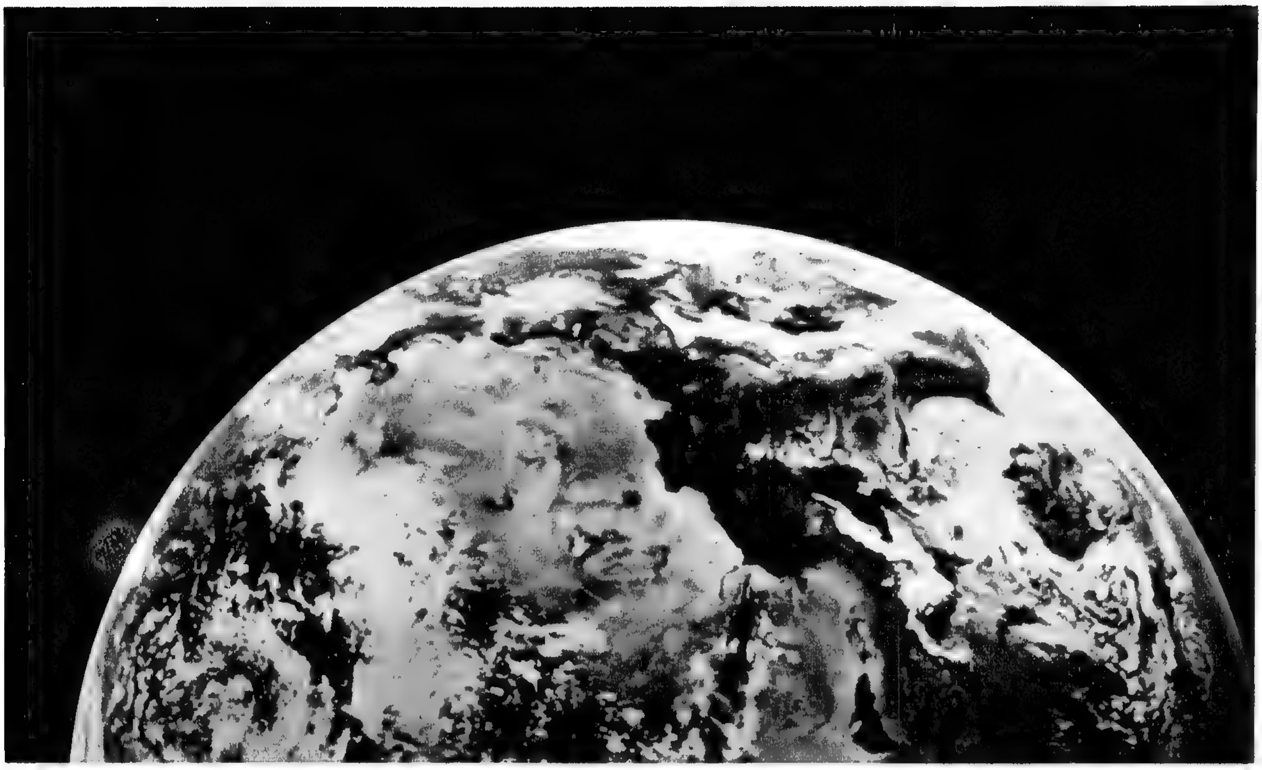
This kind of interference with the normal electrical performance of the ventricular muscles is the most dangerous, as it may result in ventricular fibrillation (uncordinated quivering of the ventricular muscles).

A monitoring system recently developed by Hewlett-Packard recognises the characteristic ECG patterns of these heart abnormalities. What is more, it keeps track of how often they occur (an occasional abnormal beat is not life-threatening) and it activates alarms if they occur often enough to be considered dangerous. In addition, the instrument accounts for the differences in normal heart beat from person to person and it also recognises and ignores electrical disturbances arising from muscle movement electrode slippage, and other interference.

This instrument is called an Arrhythmia Monitor (Hewlett-Packard Model 7822A). It's the central instrument in a system that keeps close watch on the condition of heart patients in the intensive care ward. The complete system includes a standard bedside cardiac monitor, a magnetic tape delay unit, an electrocardiograph, and a trend recorder (figure 2). The bedside monitor serves as a preamp for the Arrhythmia Monitor. The electrocardiograph and tape delay work together with the Arrhythmia Monitor to record electrocadiograms of abnormal beats. When the monitor detects an ectopic, it directs the electrocardiograph to

Figure 3. Idealised waveform for one cycle of a normal heartbeat.





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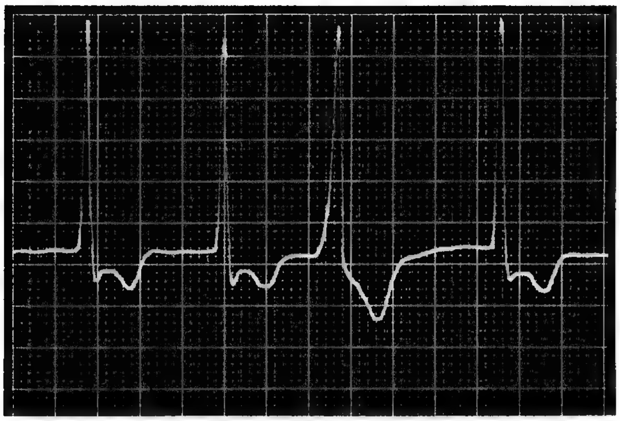


Figure 4. Abnormal (ectopic) heartbeats caused by ischemic tissue, which triggers the atrial activity prematurely.

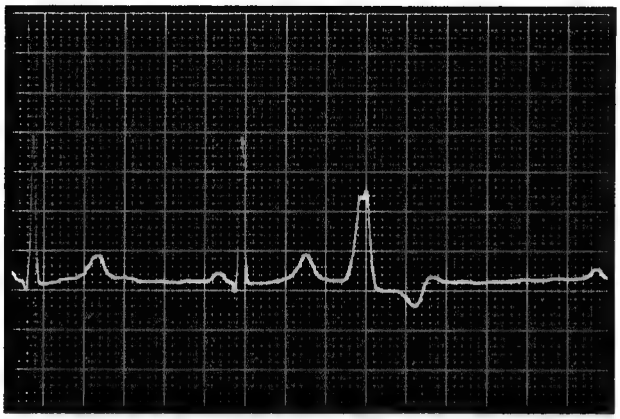


Figure 5. Typical ectopic beat caused by irritation centred in the ventricles. Note the widening of the QRS pulse.

record the delayed ECG waveform played back by the tape unit, an endless-loop recorder. This arrangement makes it possible to record a few of the heartbeats that precede and follow an ectopic beat, as well as the ectopic beat itself. Over a period of time, the ECG recorder accumulates a relatively compact record that has valuable diagnostic information about the heart's performance.

The trend recorder, a multichannel slow-speed (1 cm/hr) strip-chart recorder, plots an analog record of heart rate and a histogram of number of ectopic beats per minute, information that is supplied in analog form by the Arrhythmia Monitor. This information is of high value to the physician as it clearly shows such things about the patient's progress as how heart rate and heart irritation (number of ectopic beats per minute) responds to drugs.

This Arrhythmia Monitor now makes it easier to place the major emphasis in the care of cardiac patients on prevention, rather than resuscitation, as calmative drugs can be administered before an abnormal condition progresses to the dangerous stage.

A typical electrocardiogram of a normal heart is shown in figure 3. Disturbances in the upper part if the heart — the atria or storage chambers — affect the timing of the heartbeat. The most serious disturbances, though, arise in connection with muscular contractions of the heart's major pumping chambers, the ventricles. If irritation in the ventricular muscles gives rise to spontaneous activity, the QRS wave is not the sharp, clean spike shown but is a wider waveform like that shown in figure 5.

Heartbeat timing can be affected by many types of disturbances, or arrhythmias, including non-threatening types as well as the serious ventricular ectopic beats. Ventricular ectopic beats are not always displaced in time, though, so timing is not a consistent indicator of ventricular ectopic beats, nor is amplitude. Abnormal width however, is characteristic of these patterns. Consequently, the Arrhythmia Monitor was designed to look for widened QRS waves, the type of arrhythmia that most often precedes potentially fatal arrhythmias. It also examines heart timing to look for premature beats in those cases where the doctor is interested in disturbances in the atria.

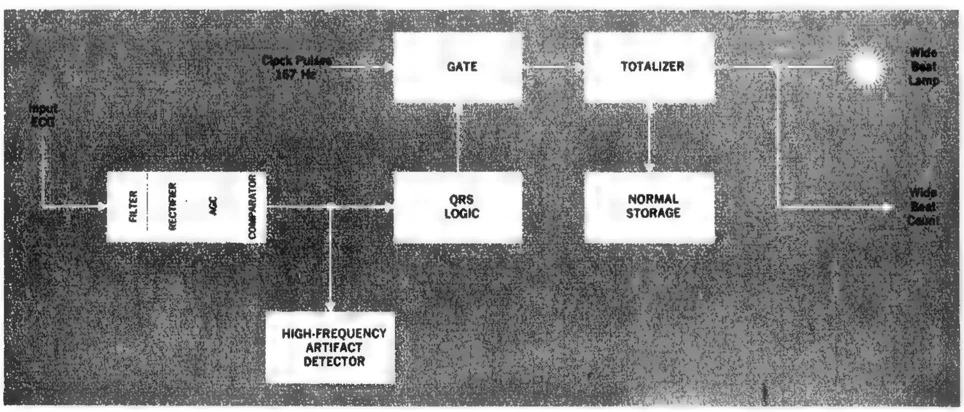
The first task of the Arrhythmia Monitor is to establish what is normal for the patient. It does this when the operator presses the STORE NORMAL pushbutton on the front panel. For about 4 seconds following momentary depression of the STORE NORMAL pushbutton, the monitor examines the input ECG waveform and stores values equivalent to the height, width, and derivative of the QRS wave. During this time, the associated ECG recorder is activated to provide visual confirmation that the ECG waveform during this time in indeed normal.

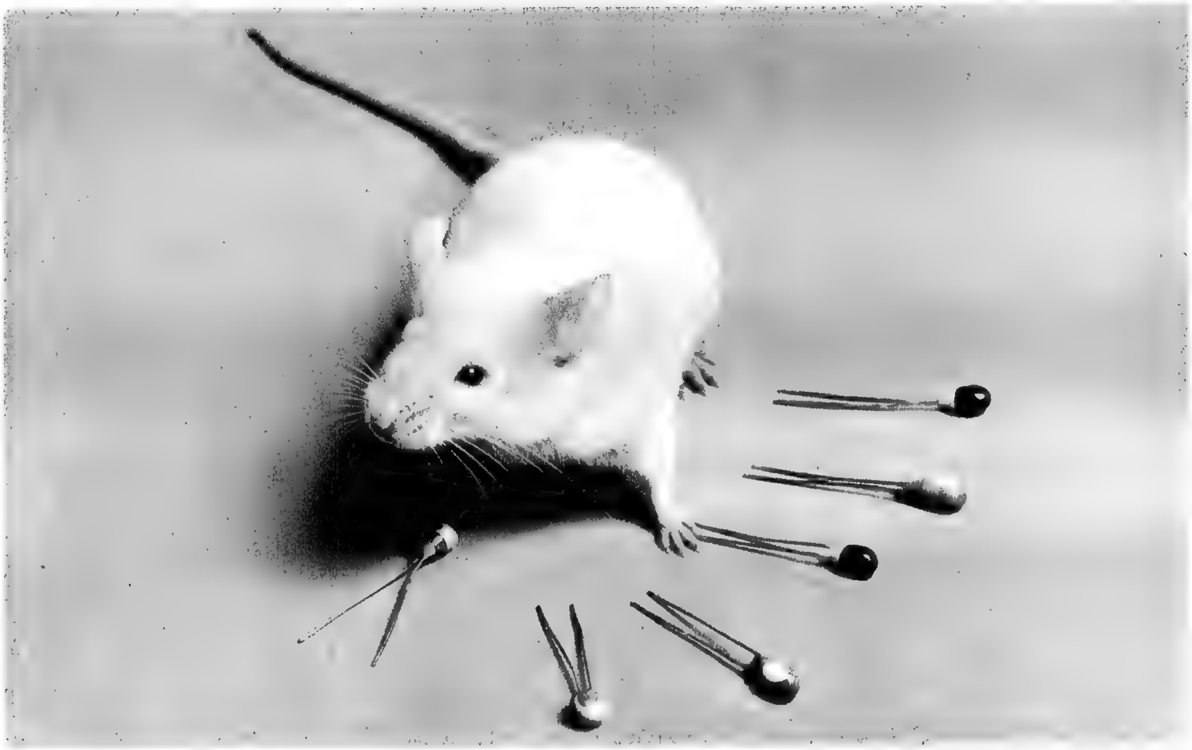
STORE NORMAL signal processing proceeds as follows: the first step is to adjust system gain to normalise waveform amplitude. The input ECG waveform, which may have a peak amplitude anywhere between 0.7 and 3 volts, is first passed through a non-linear slew-rate limiter and a filter (figure 7). The slew-rate limiter removes fast-risetime spikes on the ECG waveform which could not be physiologic in origin, such as electronic pacemaker pulses. The filter has a passband centered at 8Hz that removes both high-and low-frequency interference.

The filtered waveform is then passed through a full-wave rectifier to make operation independent of ECG signal polarity. The rectified waveform is fed though an automatic gain-contolled amplifier to an amplitude comparator. If the amplitude of any part of the waveform exceeds 1 volt, the comparator reduces the gain of the digitally controlled AGC circuit by switching in resistors until the signal amplitude no longer exceeds 1 volt. System gain is thus normalised for the ECG waveform of that particular patient. The system automatically allots 2 seconds for the gain-setting procedure, then it resets the comparator threshold to 400mV.

The next step is to establish the time of occurrence of each QRS wave. Any subsequent waveform to exceed 400mV is considered by the comparator to be a QRS wave, provided that 240mS has passed since the previous QRS. The output of the comparator then triggers a one-shot multivibrator that generates a pulse of standard width and height which for identification purposes is called the QRS gate. This pulse flashes the front-panel QRS lamp to provide a visual indicaton of heartbeat occurrence.

Figure 6. Set-up for a widened beat detector, which makes precision measurement of QRS width by examining derivative of ECG wave form (see figure 9) to sense onset and termination of QRS wave.





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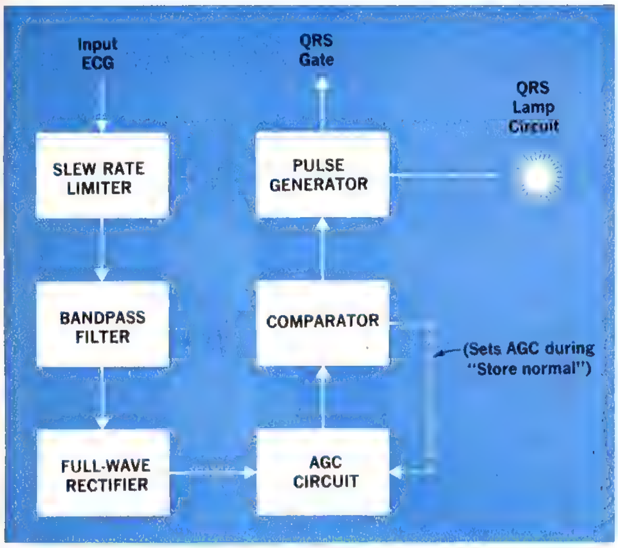
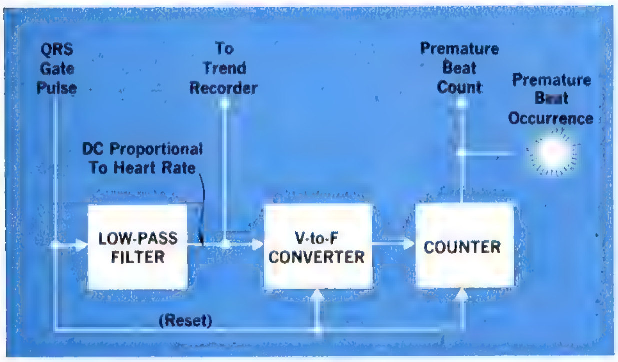
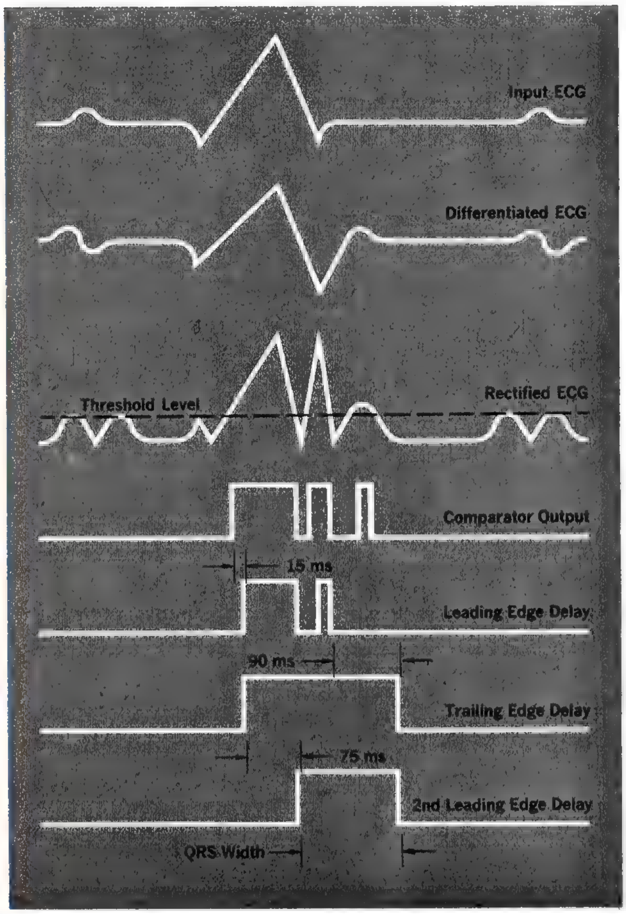






TOP LEFT. Figure 7: The QRS occurrence detector flashes QRS lamp for every heartbeat and generates pulse of standard width and height (QRS gate). BOTTOM LEFT. Figure 8: The premature beat detector compares actual beat occurrence to the time that the average heart rate indicates the beat should be expected. RIGHT. Figure 9: Waveform processing to measure QRS width.

To look for widened beats, the monitor has a second channel, operating in parallel with the QRS detector channel, that senses the beginning and end of the QRS wave (figure 6). It does this by examining the derivative (differentiated form) of the ECG waveform.

This channel also uses a filter, full-wave rectifier, AGC circuit, and amplitude comparator. This filter, however, takes the derivative of the waveform, as shown in the series of waveforms in figure 9. During the STORE NORMAL sequence, the AGC circuit is first set according to the peak value of the differentiated waveform. Following establishment of the AGC level, the comparator's threshold level is reset from 1V to 200mV.

The first part of the next waveform to exceed 200mV turns on a binary or flip-flop if the waveform stays above 200mV for more than 15mS. This is considered to be the leading edge of the QRS wave (the 15mS timing criterion eliminates false counts from noise spikes, electronic pacemaker pulses, or other short-duration interference). The output of this binary passes to another binary that has a turn-off delay of 90mS, a delay that effectively bridges the separate pulses representing the leading and trailing edges of the QRS complex so that the result is a single pulse (figure 9). Finally, a third binary delays the leading edge of the single pulse an additional 75mS so that the output is a pulse whose duration is equivalent to the width of the QRS complex. This pulse is gated by the QRS gate pulse to remove any between-beat artifacts.

To measure QRS width, the QRS-width pulse operates a gate that allows clock pulses generated at a 167Hz rate to pass to a totaliser. The count remaining in the totaliser when the gate closes represents the width of the QRS wave During STORE NORMAL, two more pulses are automatically added to this count to increase the width measurement by 12mS and the augmented total is then placed in storage.

Width comparison is performed digitally. At the conclusion of each heartbeat, following the STORE NORMAL sequence, the comparator's totaliser is cleared and the stored count placed in the totaliser as a two's complement negative number. The next heartbeat, after being differentiated and rectified, turns on the gate allowing 167Hz clock pulses to enter the totaliser. Any input that equals or exceeds the stored count causes the totaliser to overflow, which indicates that a widened beat occurred. The overflow flashes a front-panel WIDE indicator, turns on the ECG recorder if the WIDE pushbutton is depressed, and places a count in another totaliser that keeps track of the number of wide beats.

To look for premature beats, the Arrhythmia Monitor compares: the time of occurrence of a QRS wave to the time that it should occur as determined by a 4-second running average of QRS occurrences. As shown in figure 8, QRS gate pulses are fed to a low-pass filter that produces a DC voltage corresponding to a running 4-second average of the QRS gate pulses, a voltage that is proportional to heart rate (0-2.4 V = 0-240 beats/minute). This voltage is made available to the trend recorder for a record of heart rate vs time.

The filter output is also fed to a voltage-to-frequency converter that generates pulses at a rate 2.5 times that of the average heart rate as determined by the filter output. These pulses are fed to a counter.

Both the counter and the V-to-F converter are reset by each QRS gate pulse. If the counter receives two pulses from the V-to-F converter before being reset, that QRS wave is classified as occurring at the normal time. If less than two pulses are counted, however, the R wave is classified as premature. Any R-to-R interval, therefore, that is less than 80 per cent of the average R-to-R interval is classified as premature. The front-panel PRE lamp is flashed, and a count is placed in the register that keeps track of the number of premature beats.

This, then, is what the Arrhythmia Monitor does. It examines the width and timing of every QRS wave regardless of how the controls are set. The front-panel controls merely select what the instrument is to do with the resulting information, allowing the system to be tailored to the needs of the particular patient. (From "Hewlett-Packard Journal," by arrangement.)

FAST SCANNING SONAR GIVES VISUAL DISPLAY

A fast scanning sonar developed in the U.K. can present information on a PPI type display. Work is now proceeding on a new system which will operate with computers to give better signal/noise ratio.

Although optical and radio telescopes enable us to probe the depths of space, yet light can be stopped by a few centimetres of muddy water and the penetration of microwave signals into water is too small to be of any practical use. But sound waves travel faster, and further, through water than they do through air. Sonar therefore often povides the only practicable means of gaining information about the underwater world, whether it be in the turbid waters near the coast or in the blackness of the ocean depths. The design of the apparatus naturally depends on the use for which it is intended. Equipment can range from small hand-held sonar sets carried by divers to bulky and complicated ship-borne sets with effective ranges of several kilometres.

An echo sounder, of the type fitted in most ships today, illustrates the essential features of any sonar system. A burst of sound is emitted from an electro-acoustic transducer and at the same time it is recorded on a suitable time-base, provided, for example, by a moving paper chart or a cathode-ray oscilloscope. The echo returned from the sea bed is picked up by another transducer, converted into an electrical signal, amplified and recorded on the same time-base. The time taken between the sound leaving the transmitter and its echo being received back gives a measure of the distance of the ship from the bottom of the seas. As the ship moves on its course, successive echo pulses trace out the profile of the sea bed.

Instead of using the sonar as a vertical echo sounder it may be designed to work in an almost horizontal direction. In a "side-search" sonar of this kind the sound waves strike the sea bed at an angle slanted so that features on the sea bed can be distinguished by the differing time of arrival of their echoes. As successive echo traces are displayed a continuous picture is built up.

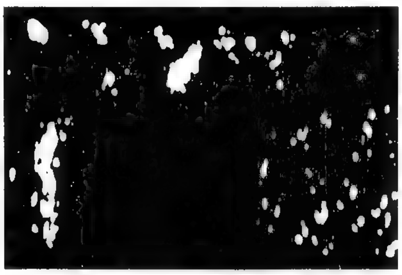
Early sonar experimenters noticed that significant echoes were sometimes obtained from fish as well as from the sea bed. It was soon realised that, far from being merely a nuisance, this would provide a valuable method of locating fish. Specialised sonars for fish detection are now quite common on the large commercial fishing vessels.

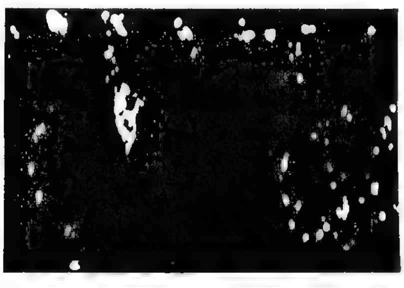
A feature common to both the echo sounder and the side-search sonar is the use of the forward motion of the ship to provide a scanning action as the sound beam is swept over the target area. This is satisfactory for recording and displaying the slowly-changing pattern of the sea bed and looking for wrecks, pipe-lines and so on, but it has serious shortcomings when applied to moving targets, such as fish, because the scanning process is too low and not flexible enough. It would be quite natural to try and overcome this difficulty by following radar practice and arranging for the acoustic transducer to be rotated or rocked from side to side mechanically. This does indeed increase the capability of the sonar and commercial fishery sonars working on this principle have been developed.

Research at the University of Birmingham drew attention to the advantages to be gained by using a sonar with a relatively narrow sound beam, capable of resolving individual fish in a shoal and then applying electronic beam-deflection to produce a scanning action fast enough to follow the motion of the fish. This represented a big step forward because, for the first time, it produced a practically continuous pictorial display of a large number of targets, moving or otherwise, in their correct positions. Moving fish can be made to appear as moving dots on a display screen in much the same way as aircraft appear on the display screen of radar set.

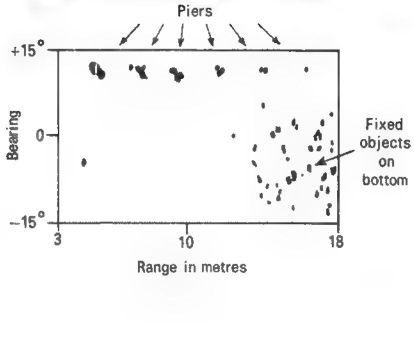
Briefly, the idea is to carry out the scanning deflection of the receiver beam pattern by purely electronic means while the receiver array itself remains stationary. This method not only avoids the problems involved in providing mechanical means of scanning but it also makes it possible for sufficiently high scanning rates to be achieved to enable the complete angular scanning operation to be carried out within the duration of a single transmitted signal pulse. This method has been applied to a sonar which scans in one direction only, the information received being presented on a radar type (PPI) display.

The basic principle of electronic scanning depends on the fact that the total directional pattern of a row of receivers can be deflected, so that its main beam points in a



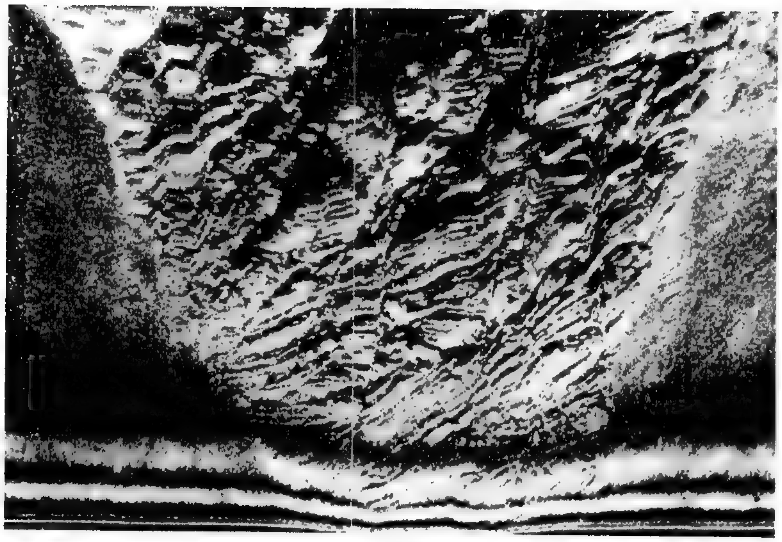


Four views from the display screen of the University of Birmingham's scanning sonar, with key diagram. The diagrams show only the fixed objects. The other echoes are small fish shoals.



By
Dr V. G. Welsby, D.Sc., F.I.E.E., F.I.E.R.E.

Reader in Electrical Engineering, University of Birmingham.



Typical record obtained with a side-search sonar used for oceanographic survey. It shows a ridge of slate beds surrounded by an almost flat sand floor.

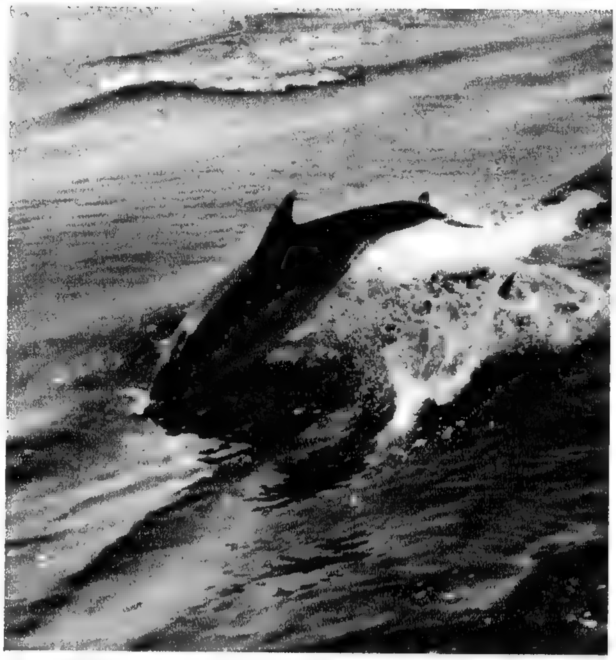
different direction, by introducing graduated time delays into the electrical outputs of the individual receiver elements. Electronic circuitry is then used to cause these delays to vary with time so that the directional beam is swept repeatedly across the chosen sector. Such a scanning process will only produce a line image of the scene because it scans in only one dimension. To obtain the equivalent of an optical image-forming system, it is necessary to have not just a row of receiving elements but a complete two-dimensional matrix of transducers with a complicated system of circuits to carry out the scanning operation.

The importance of the technique lies in the fact that the angle of deflection can be varied very rapidly simply by arranging for the electronic delays to vary with time. For example it is possible to scan over a 30 deg. sector angle at a rate of up to 10,000 sweeps/second; a rate which would be completely out of the question for any mechanical system. It is this ability to scan at very high speed that makes a sonar with a receiver of this type so useful when a continuous display of a number of rapidly moving targets is required.

The electronic circuits used in the original experimental system built by the University of Birmingham are by no means unique. There are several other ways in which the necessary time-varying delays can be obtained. The main interest lies in the fact that this was the first high-resolution fast-scanning sonar to be designed specifically for oceanographical and biological research.

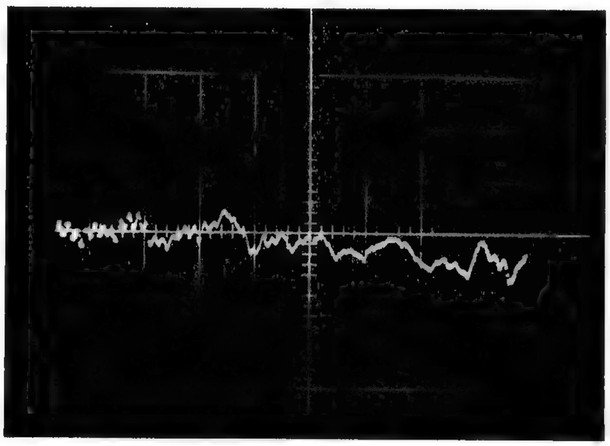
More recently a completely new type of high-resolution sonar, working on a different principle, and designed to work with digital computers, has been developed, also at the University of Birmingham. To explain how it works, suppose that a sound wave approaches a transducer array from a given direction. The resulting electrical output from each element will lag behind that from the previous one and, under ideal conditions, all the time lags between the outputs of adjacent elements in the array will be the same and will be characteristic of the direction from which the wave has come.

Even in the presence of noise and interference, the average value of the delays will still indicate the probable direction of approach of the wave. Although a "delay-measuring" receiver of this kind tends to give ambiguous results if it is presented simultaneously with waves from several different directions it is nevertheless possible to design it in such a way that it either indicates the correct direction of the strongest target, within a given small interval of time, or it gives no output at all during that time interval if it is unable to determine the direction. In practice, although it is true that a certain number of echoes will be lost because the system is unable to obtain a clear decision about the directions of echoes which arrive at one time from different directions, the overall performance can approach that of the beam-scanning system. The reason for this that the echo from, for example, a fish always fluctuates with time, (for reasons not unlike those which cause the light from a star to twinkle when viewed through the Earth's atmosphere). So the chances of two echoes arriving simultaneously from different directions is not as great as might at first appear. The main advantage of the "delay-measuring" type of sonar receiver is its relative simplicity and also that it lends itself to the use of modern digital computer techniques. ■



ABOVE: Dolphins at play in the English Channel. These marine animals navigate and communicate with each other by a system similar to man-made sonar.

BELOW: Oscilloscope trace of a dolphin "sonar" pulse.



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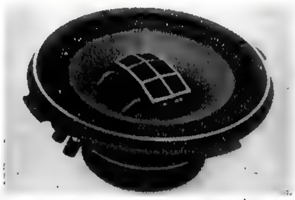

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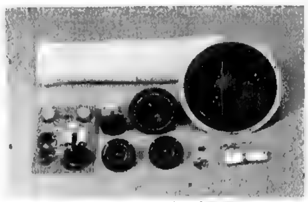

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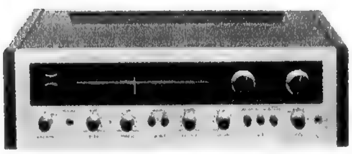

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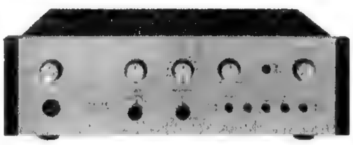

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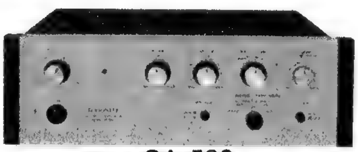

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COMPUTER IN A SAWMILL

A timber company in Sweden has put into service a fully automated sawmill in which a computer decides how best to cut each log and then directs bandsaws to make the appropriate cuts.

The automated sawmill can process large logs in 27 seconds, during which time the logs are de-barked, inspected for hidden metal, graded, measured, and cut to size. All these operations are carried out while the logs are moving along a high-speed conveyor system, which eventually feeds the logs to a battery of nine 60in bandsaws, arranged in two lines of four and a single saw which makes the final cut.This battery cuts each log into 10 planks.

As it passes through the first pair of saws, these cut two planks from the outside of the log. The three succeeding pairs of saws each cut two more planks, then the final saw cuts the remaining piece through the middle.

The diagrams show the various stages the logs encounter in their progress through the mill.

As each log is fed into the system, it passes through a de-barking station (1). The next stage is a metal detector (2). Detection of any metal objects imbedded in the timber, such as nails, bullets and shell fragments for example, will prevent damage to the expensive bandsaws. If metal is present, the metal detector generates a pulse which activates a rejection mechanism. A search with a hand-held metal detector is then carried out to locate and remove the metal, before the log is fed once again to the system.

Next is an X-ray room (3), the purpose of which is twofold. Firstly, it enables the quality of the timber to be ascertained, by revealing the extent of knots, rot and other defects. Secondly, it reveals the presence of non-metallic objects which could damage the band saws, such as stones embedded in the timber. The X-ray image is transmitted to the inspection point (5) where it is displayed on a TV monitor. A closed-circuit TV system is also installed to allow visual inspection of the log exterior. The camera (4) is linked by cable to a second monitor at position 5.

The operator in position 5, having determined the quality of a log, presses one of a series of buttons representing the various grades of timber. This generates a signal, which is fed directly to a data-processing unit.

When they have passed the inspection point, logs are picked up by a series of endless elevator belts, raised to the higher level and deposited on a conveyor leading directly to the bandsaws. Point 6 is a supervisory position, overlooking the saw line. Here, a supervisor operates alignment and centring gear to bring the logs into the correct position for the saws.

Before passing through the saw line, the logs are automatically measured for length and diameter by an electronic system. This has two lines of electric lamps, at right angles to each other, with corresponding sets of photoelectric cells. As a log passes through the system it obscures a certain number of lamps and the photoelectric cells signal the diameter and length of the logs to the computer by indicating the number of lamps obscured, and the time taken by a log to pass the system. Measurements are taken 20 times a second, to determine the maximum and minimum diameters.

All the information obtained so far for each log as it has progressed through the system has been stored by the data processor (11), and it now decides automatically the settings for the four pairs of bandsaws before the log is cut. (The last, single saw is permanently fixed, centred on the sawline, to cut the remaining core through the centre.) The data processor has been programmed to select the best arrangement of cuts for the size and grade of log, and it adjusts the position of the bandsaw blades automatically as the log approaches. However, as a log leaves one pair of bandsaws, the next log is already approaching the same bandsaws in its turn. The data processor must therefore be capable of storing the information appropriate to each log, and delivering the corresponding instruction to the four pairs of saws.

It does this by storing the information relating to size and quality on a magnetic storage drum which has a reading head for each of the four pairs of saws. The rotation of the drum is

(Continued overleaf)

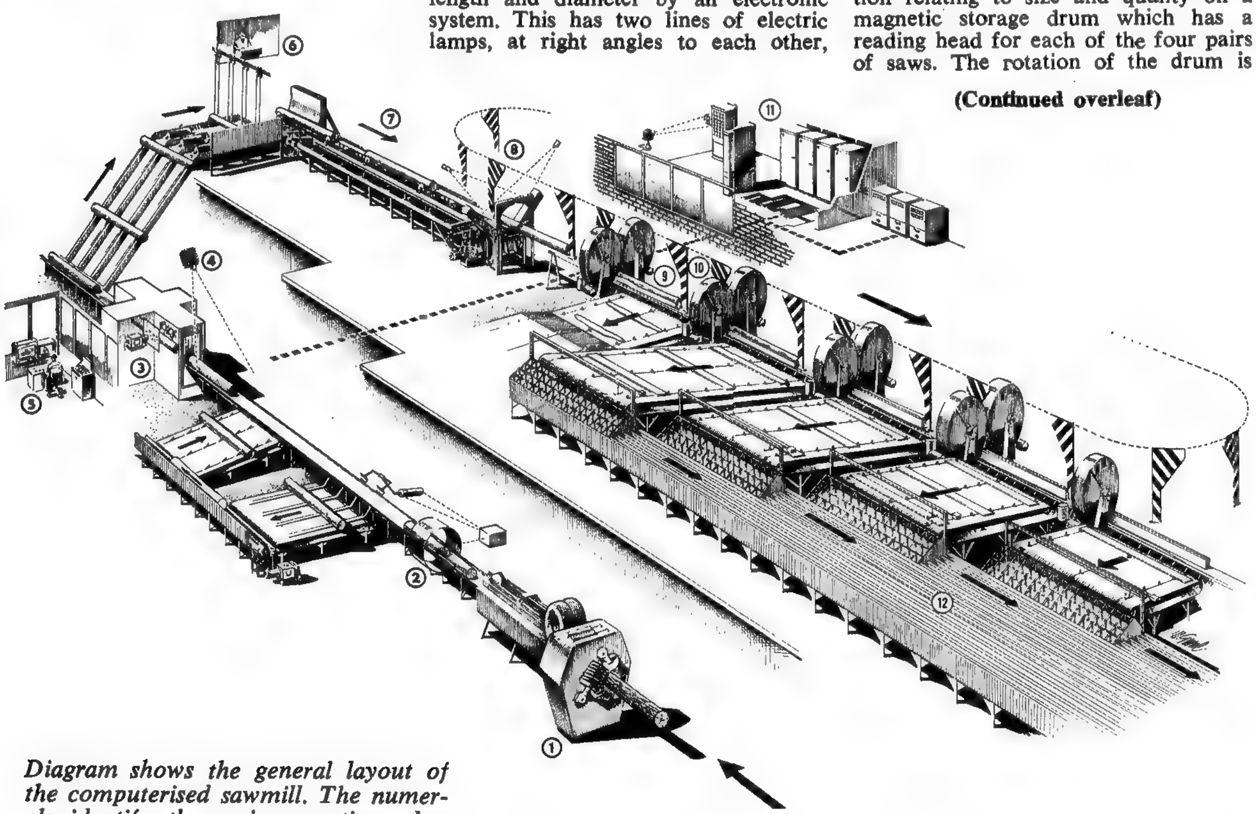
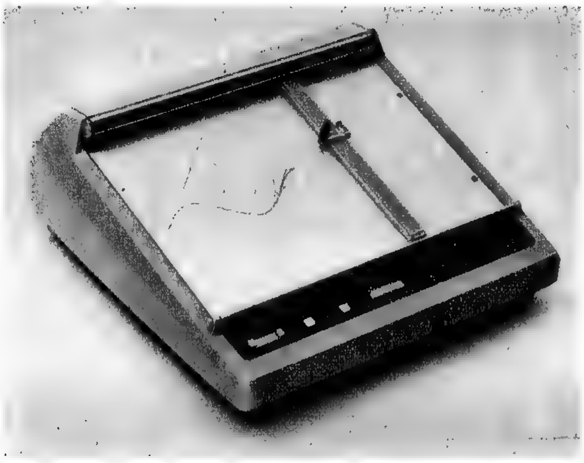


Diagram shows the general layout of the computerised sawmill. The numerals identify the various sections described in the text.



PLOTTER DRAWS GRAPHS FROM DIGITAL DATA

Hewlett-Packard has announced a new graphic plotter, which, the company says, for the first time provides facilities for drawing graphs from numbers or algebraic equations without special programming.

A graphic solution of a problem is often more useful than long lists of numbers. It is easier to understand and interpret. This new plotter, the Hewlett-Packard Model 7200A Graphic Plotter, makes graphical solutions of engineering, business and scientific problems available immediately and at low cost. Graphs can be points, irregular curves, circles, straight lines, ellipses, contours — in fact, any shape. Business graphs such as bar or pie charts can be drawn.

Designed to operate from data coming directly from a teletypewriter terminal, either on line or off line, the graphic plotter is called by its maker, "the closest thing to automated graphics ever available in a graphical instrument." Besides drawing graphs, it handles scaling, curve fitting and performs other basics of plotting. This frees the operator of the usually tedious procedures in creating a graph, and allows him to concentrate solely on his problem. Because the plotter uses a simple input format, the operator can develop graphs directly, using any source language such as BASIC or FORTRAN.

The Model 7200A accepts standard EIA ASCII inputs from the teletypewriter and draws vectors between points to form smooth curves. No special software is required; the plotter can be used wherever a teletypewriter can be used.

Software (user utility routines) is available to help the user create graphics. Such chores as scaling, axis generation, formatting, and co-ordinate transformation are handled by these routines. Other utility routines provide curve generation, curve synthesis (using several forms of curve-fitting, including spline functions and least-square-fit), absolute presentation of input data, contour mapping (including three-dimensional plotting), and geometric figures (circle, line, ellipse, etc.).

Using these utility routines, an operator not skilled in programming can produce finished graphs directly from input data or from complex equations merely by supplying the equation and the range of interest to the computer in any common source language; it is not necessary for him to define individual data points on the curve.

Users of the Model 7200A Graphic Plotter will be reached mainly through time-share service bureaus, the makers say, and availability of the plotter to time-share bureaus could expand their services, and increase the productivity and use of time-share terminals. The company feels that the plotter will attract new users to time-share systems, such as businessmen who will be able to develop useful charts from hard-to-interpret tabulated data, and application program libraries being developed by almost every time share service bureau could be greatly enhanced with a graphical output.

Used with a teletypewriter terminal, the Model 7200A Graphic Plotter can draw graphs of computer-solved problems with no special programming requirements.

SAWMILL COMPUTER . . . continued

synchronised with the log-feed mechanism, and the reading heads are so positioned that the instructions to the saws are received just before the log arrives at that particular sawing station. Each head reads the same information from the drum, but has its own program panel which interprets the information in the correct manner for its associated saw.

It is at this point that the improvement in production rate can be appreciated. Logs are moving along the conveyor system at speeds up to 200ft per minute (the speed is varied automatically according to the diameter of the thickest log on the sawing line at the time) and each bandsaw is automatically reset for the approaching log when it is only 8ft away. This means that there is an interval of only 2½ seconds from the time that cutting is completed on one log and commences on the next.

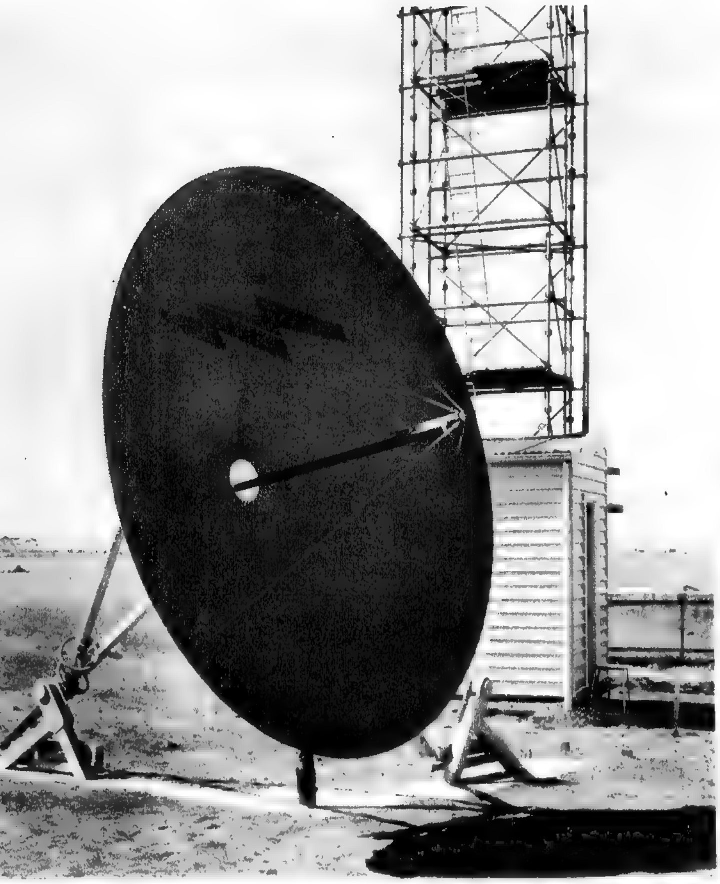
This is far faster than even the most efficient human operators.

The final stage in the system is sorting and stacking, and here the data processor again plays a major role. At each sawing point, the two boards produced fall onto a conveyor moving at right angles to the main conveyor. The rack-like construction at the end of the cross-conveyor, accepts the boards and drops them into one of eight slots in the main conveyor (12), according to their thickness and quality. The information relating to thickness is obtained by measurement on the cross-conveyor, while that concerning quality is provided by the data processor. The boards are then carried off, edgewise, to the appropriate stacks.

Production is maintained at a steady rate, and from the time the logs enter the mill until they emerge as cut boards, they are kept moving continually by the conveyor system. Apart from labour at the reception and input points, the mill is operated by only two men, who work in inspection and supervisory capacities, yet it is capable of cutting nearly 3,000 logs per shift.

Phones for the Outback

SATELLITE MAY SERVE REMOTE AREAS



A 12ft diameter aerial of the type proposed for installation near subscribers' homes in outback areas of Australia.

Telephone subscribers (and would-be subscribers) living in remote areas of Australia may eventually be linked into the Post Office's national telephone network by means of satellites. Tests to determine the technical factors controlling the flexibility of such a system are currently being conducted by the Post Office in co-operation with NASA.

For some years the Post Office has been working towards achieving a completely automatic telephone system in Australia, and it is now policy that all new subscribers services must be suitable for automatic working. In general practice, subscribers are connected by physical line pairs to automatic exchanges, but as an alternative to physical lines, radio telephone links have been in limited use for some time where it is more economical to connect subscribers this way. Experiments are now being made on the technical aspects of using satellities to provide a service to subscribers who are too far from an exchange to be served by either a physical line or a radio system.

In contrast to conventional exchange/subscriber radiotelephone links, subscribers to a satellite system would be linked directly through the satellite repeater without intervention by an exchange. However, supervision and control of such a network and its connection to the national telephone network would need to be carried out by means of a control station.

The major advantage of a satellite system would be that it could be used by earth stations anywhere in the area covered by the satellite's antenna. If a satellite was positioned so as to cover the whole of Australia, communications could be established to any point of the country by using suitable earth stations.

Last year the Post Office Research Laboratories carried out a systems study covering the provision of subscriber telecommunication services to remote areas by means of satellites. The conclusions contained in the report on this systems study were that a satellite service to telephone subscribers might be technically feasible when based on a multi-access method, which would depend on frequency division multiplex for channel separation and digital modulation of individual carriers carrying the voice signals. It was suggested that Delta modulation was the preferred digital modulation method.

The purpose of the current round of experiments is to evaluate some technical factors thrown up in this preliminary systems study and to obtain engineering data needed for a future systems implementation.

As would a future system, the experiments and related studies involve the use of small earth stations such as the prototype model which has been installed at Mt. Cottrell in Melbourne. This small station will experimentally operate through the ATS-1 satellite of the National Aeronautics and Space Administration (NASA), which is located over the Pacific, to the ATS earth station at Cooby Creek, Qld.

The current experimental program, which will continue until June this year, is based on the use of the microwave transponder in ATS-1 to supply the space segment. (A "transponder" is a receiver-transmitter combination which receives on one frequency and transmits on another without operating on the information carrying signals.) The facilities of the Cooby Creek Station are being used to simulate a multi-channel earth station, required to connect the satellite subscribers into the national telephone network and to act as a network control and interface station.

The Australian National Telecommunications Network reflects the concentration of population in the South-East corner of the continent, and to some extent in the South-West corner, and the scattered nature of settlement throughout the remainder of Australia. Recent developments particularly in mineral exploration, have resulted in increasing pressure for the supply of telecommunication services to those sparsely settled areas.

A major problem for the Post Office is to supply telecommunication services to a number of very remote homesteads which it is not practicable to connect to the network by terrestrial means. Illustrating this situation is the fact that the Royal Flying Doctor Service is providing rudimentary communications to and between approximately 3,500 outstations. The service operates on common use high-frequency channels and outstations are not given voice connection to the national telephone network. In addition, more than 36,000 remote subscribers are connected to exchanges by means of part-privately erected lines, which in many cases operate as a party line service. Nine hundred of these lines are over 30 miles long and may extend to up to 300 miles. The majority of these telephone services are not technically suitable for connection into an automatic network.

The HF services and many of the part-privately erected line services would form the bulk of subscribers which could be served by means of satellite subscriber services, if such were technically and economically feasible. However, a

number of problems are associated with integrating a domestic satellite system into the national telephone network.

Most of these problems arise from the time delay inherent in transmission through a geo-stationary satellite. The reason for using a geo-stationary satellite for this purpose is primarily to avoid the need for the earth stations to continuously track a moving satellite in a lower orbit. Any tracking operation would increase the cost of the earth station considerably and would price it out of consideration.

The transmission delay through a geo-stationary satellite is in the order of a quarter second, consequently the round trip delay including extension from the earth station may be more than half a second. This creates human factor problems in adapting to a conversation containing such delays and to this stage of experience it is doubtful whether a satisfactory service can be obtained when two such satellite links are cascaded. However, this is as yet an undecided human factor limitation.

More readily definable technical problems arise in the area of systems control known as signalling in automatic telephone networks. The conventional existing signalling systems would not satisfy the conditions obtaining in such a satellite system. Consequently a major portion of future investigations will be devoted to experimentation with special signalling techniques. Any interconnection with the conventional automatic telephone network would then involve interface translation equipment to make the signalling system used in the satellite system compatible with that used in the national and international terrestrial systems.

To reduce the maximum time delay as far as possible to that encountered in a single satellite link the systems design for the current investigation aims at providing all services within Australia with not more than one satellite link. This is particularly important if one envisages that any such national subscriber may be connected into an international network containing at least one more satellite link and consequently may create time delays between subscribers in the order of 1 second.

Such delays may be acceptable in international links where the subscribers would be psychologically conditioned to special circumstances. However, within a national network they may not be acceptable when the average user is accustomed to alternative, high quality terrestrial circuits which do not contain such transmission delays.

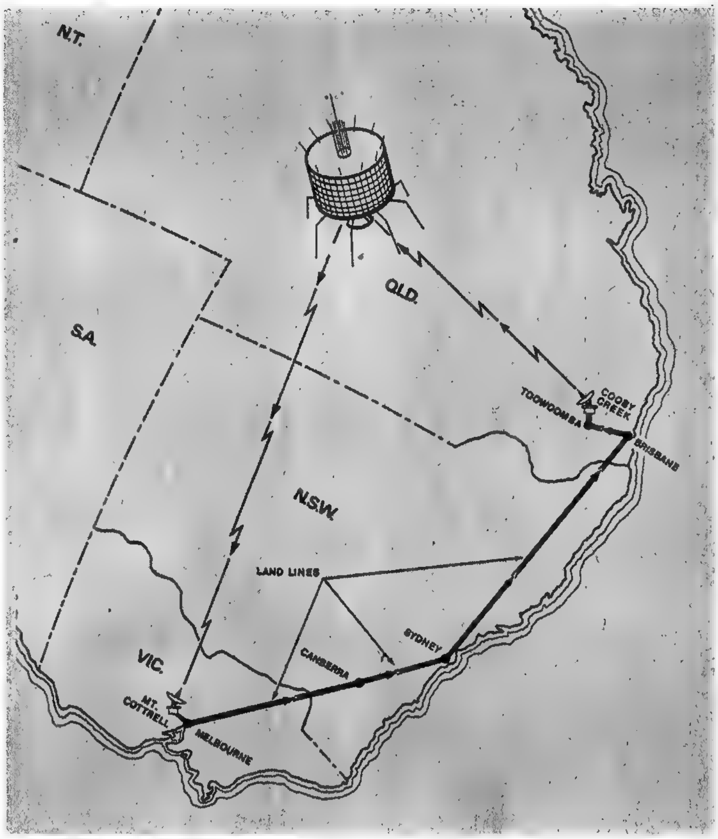
The system aspects of such a subscriber satellite communication system are substantially different form those obtaining in trunk satellite communication systems such as those used by the O.T.C.

Satellite trunk systems within Australia, however, have recently been introduced between Sydney and Perth, making use of the O.T.C. earth stations at Moree and Carnarvon and the Intelsat III satellite over the Pacific. This is the first case of regular commercial trunk telephone operations within a country's continental border, in contrast to the domestic circuits operated by the United States over a geo-stationary satellite which provide connections between the islands of Hawaii and mainland U.S.A.

From this domestic operation, the Post Office is gaining valuable experience in the development of its proposals for a national system. In addition, the results of surveys of customer reaction may create considerable interest from a point of view of the acceptability of long transmission delays within a domestic telephone network.

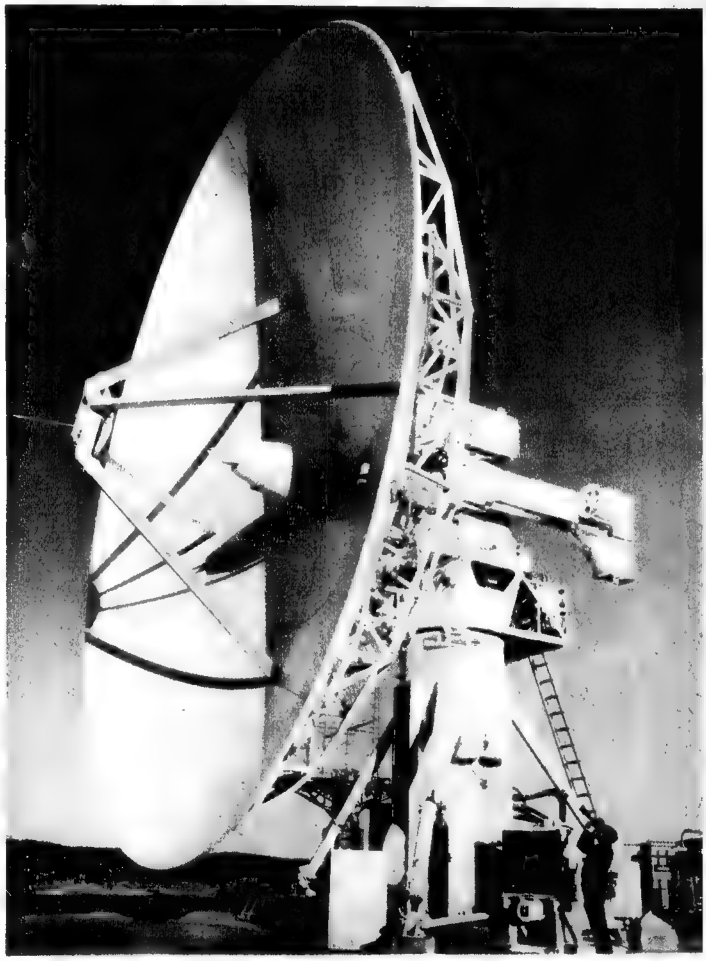
Overseas countries which propose to establish satellite systems for domestic communication operations include Canada, the U.S.A. and Japan. There are also two regional proposals in Europe. A domestic satellite system is operating in the Soviet Union, comprising a number of non-stationary satellites in elliptical orbits which have a period of approximately 12 hours. This system is used in the distribution of television programs from a central earth station to regional earth stations each equipped with 40ft parabolic aerials which must follow the path of the satellites. As one satellite disappears over the horizon the receiving station must switch to a succeeding one.

Earlier studies on the economic factors of satellite communications carried out by the Australian Post Office found that on the cost structure and technology at the time, a satellite system would not be as economical as a terrestrial system for provision of trunk and television facilities. There are indications, however, that the economic factors are improving, especially as it is now possible to envisage a system which would incorporate not only services normally covered by terrestrial broadband systems but would also include direct subscriber telephone services and a nationwide television distribution system, again to comparatively small earth stations in remote locations which couldn't possibly be provided with conventional TV facilities.



ABOVE: Circuit arrangement for the current series of experiments with the ATS-1 satellite.

BELOW: The 40ft diameter aerial at the Satellite Earth Station, Cooby Creek, Queensland.



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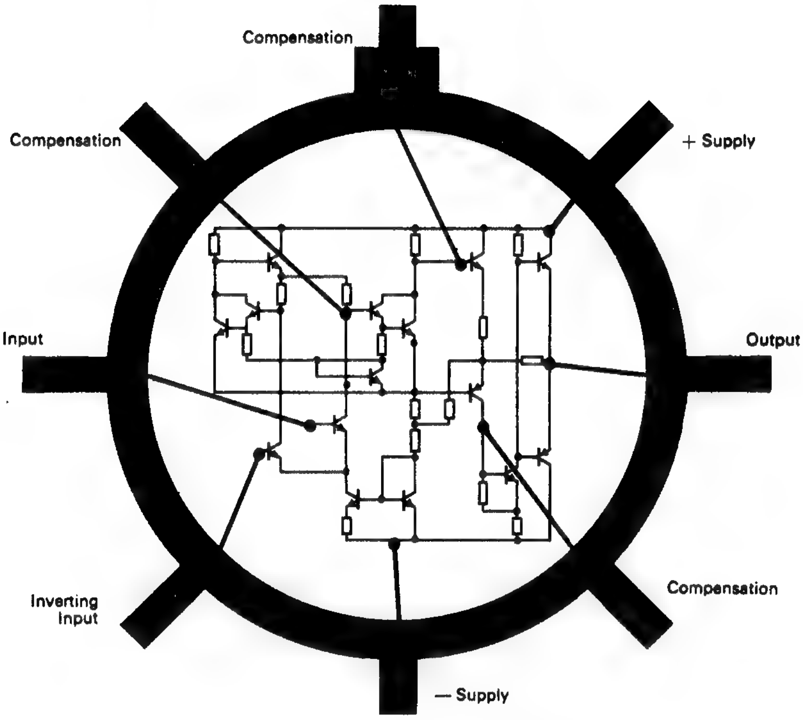

The TAA521 is a general purpose, high gain amplifier for use in a wide range of well established applications. It is monolithic and features low offset; high input impedance; low power consumption; large input common-mode range; and high output swing under load. It is ideal for low-level instrumentation, DC servo systems, high impedance analogue computers, and for generating special linear and non-linear transfer functions.

Typical Characteristics of Mullard Linear IC Op Amps

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Supply voltages	+12 −6	+12 −6	+12 −6	+15 −15	+15 −15	+15 −15	+15 −15	V V
Input bias current	2.5	2.0	5.0	0.3	0.2	0.25	0.12	μA
Input voltage range	+0.5 −4.0	+1.5 −6.0	+0.5 −4.0	±10	±10	±12	±12	V
Input impedance	32	40	20	250	250	400	800	kΩ
Input offset voltage	1.5	0.5	7.5	2.0	2.0	2.0	1.0	mV
Gain	3400	3600	2300	45 000	45 000	150 000	160 000	
Output voltage	±5.3	±5.3	±5.3	±14	±14	±14	±14	V
Temperature range	0 to +70	−55 to +125	−25 to +100	0 to +70	−55 to +125	0 to +70	−55 to +125	°C
Frequency performance (Bandwidth for Unity Gain)	5.0	5.0	5.0	1.0	1.0	1.0	1.0	MHz

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EDUCATION — MODERN STYLE

Audio — Visual Teaching Aids at Waverley College

A new "Middle School" wing of Sydney's Waverley College, officially opened by the Prime Minister, Mr Gorton, recently, is equipped with a unique, comprehensive audio/visual system for the presentation of sound and television educational material.

The Middle School is designed to accommodate up to 600 boys in Forms II, III and IV — the three years leading up to the School Certificate examination. Since the building is completely separate and self-contained, it provided an opportunity to consider the use of audio/visual techniques to supplement conventional teaching methods. The decision was made to install a completely integrated system, with a complex reticulation of sound and video signals, as part of the building construction.

The installation has a full range of audio and visual aids to teaching, including a closed-circuit television system with four cameras and three video tape recorders, projectors for film, film strip and slides, overhead projectors, sound tape recorders, disc turntables and radio tuners.

The system was designed and built by Australian Video Engineering Division, a unit of Electronic Industries Ltd., at its plant in The Crescent, Annandale, N.S.W. The Division's manager, Mr F. Williams, said the system was designed for operation by one man, who will be producer, director and cameraman for the production of TV programs and other material.

Because there is very little material available which is appropriate to the School Certificate curriculum, the school plans to produce its own programs. It is expected that some material transmitted from the A.B.C. National TV stations will be presented as received, and some filmed material will be copied on to video tape, but in the main the school plans to rely on its own resources. The production target is 1,305 20-minute programs, to be used over the three years of study; that is, each Form will view 435 programs during the year. The subjects covered will be English, Geography, Science, Mathematics, Languages, Commerce, Art, Music and Religion.

Each teachers desk in the classrooms and laboratories is designed as a control unit and is fitted with the following facilities: overhead projector, which is retractable when not in use; radio tuner for direct reception of educational broadcasts; tape recorder, which will be used both for recording and replay; remote controls for the operation of slide and film strip projectors mounted at the back of the classroom; microphone, connected to the classroom P.A. system; intercom system which allows communication with all other points in the network. The sound from all sources is reproduced by two high-quality loudspeakers. The Headmaster and Middle Schoolmaster can override the system at any time to make announcements, and an automatic over-ride is provided for change of period and some other signals.

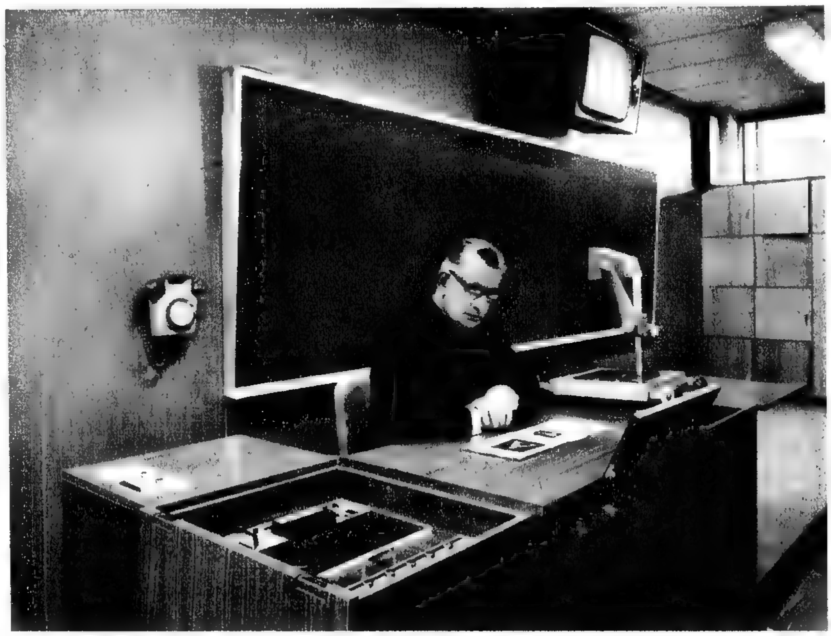
The overhead projectors are of a type which allow the teacher to present material to the class without leaving his seat. They are arranged to project at right angles, by means of prism, from a corner of the teacher's desk to a screen behind him. The material he wishes to present is written on a transparent (acetate) film roll, by using a special type of pen. Used sections of the acetate roll are wound on to allow a clean section to be used. The roll can be cleaned afterwards by a solvent material. Alternatively material prepared in advance can be used, and stored for repeated use.

Each classroom has one monitor for presentation of closed-circuit and off-air television programs. There are two studios associated with the closed circuit TV system. The main studio is equipped with two cameras and the three video recorders which operate with normal 1in video tape. Arrangements have been made for off-air recording so that programs can be replayed at a later date. A patch field system permits a program to be sent to any one of the points of reception, or to all simultaneously. A carefully designed system of monitoring and communication will ensure control of timing, operation and quality. One of the three video recorders is specially fitted for editing of tapes and all are portable for field use.

The second studio is a demonstration laboratory, equipped with two cameras. The cameras in the main studio can be remotely controlled, and all four cameras can be dismounted for use outside studios. The remote-control facilities allow the operator to operate the zoom, pan and tilt, focus, beam and target controls from his console, using his monitors to check for picture quality and direction.

Students can make individual use of the system's facilities in the library, which is equipped with three channels for TV replay, six channels for slide projection and 18 points for audio tape replay. By arrangement with the librarian, they can see TV programs and slides, or hear tapes they might have missed, or those they wish to see or hear again to study the subject more closely. Each outlet is provided with headphones only for sound, so that ambient noise level is minimal. Audio tape and slide replay is controlled from the studio and cannot be interrupted at reception points.

Although this installation has been specially designed for the new building, the school says it is not just an experiment. A brochure published to mark the opening contains the comment: "It is a serious use of advanced educational media on a scale and in a manner not known in Australia. It will create widespread interest and be under intense scrutiny. We believe that its effect will be dynamic in broadening the horizons and expanding the minds of our pupils."



One of the teacher's desks, fitted with overhead projector (right) tape recorder microphone, radio tuner and remote controls for film and slide projectors.

TECHNICAL DIGEST

Scottish Bank uses Closed-Circuit TV for Security

In Scotland, a branch of the Clydesdale Bank in Buchanan Street, Glasgow, conducts all its business with customers remotely, using closed-circuit television.

In this new branch of the Clydesdale, the customer is linked by closed circuit television to the teller. Complete privacy is ensured for his transactions. At the same time, the teller is linked by television to other departments of the bank, making quite certain that details of the transaction can be provided as quickly as required.

All the equipment was designed by Cameron and Company, Glasgow, and manufactured by Philips Industries. It consists of a monitor in each of two booths, showing either the main banking hall, or the teller's face. It should be noted that the main banking hall of the branch is two city blocks away from the position of the booths.

The teller has a 19in monitor for each of the booths, and a security monitor for surveillance of the area outside the booths. In front of the teller there are two cameras connected by a special video audio switching unit to the booths' monitors. To the teller's right hand side there is a special document viewing unit which uses a television camera and monitor for viewing the passbook or cheque when inserted into the viewer. The monitor of this viewer is in the main ledger department at the main office.

A further monitor reproduces a picture of customers' ledger account, which can be signalled down from the ledger department for verification of his bank balance.

In the ledger department itself a special ledger viewer unit is situated alongside the preview monitor and the monitor for reception of the passbook transmission from the teller's viewer.

In the main banking hall at head office, a television camera transmits an overall view of the normal business going on in the hall through a video switching unit, to the teller's monitors, and to the two monitors in the booths. There is provision by telephone for direct communication between a customer in the booth and the ledger department itself or the manager.

On entering one of the two booths at street level, the client is seen by the teller on his monitor in the banking hall. At the same time the customer can see on his monitor a picture relayed from the main banking hall itself which gives him a "banking atmosphere."

As soon as the customer has entered the booth, the door is locked by a magnetic lock controlled by the teller. Customer and teller can see each other on their respective monitors.

The teller has a unit with a black, green and red button, these colours being related to the lights on the cameras looking at the teller and also at the customer. The black button is for the "reset relay," for cancelling at the end of the transaction.

As soon as the customer enters, the teller presses either the red or the green button according to which booth is in use. These buttons are electrically and mechanically interlocked so that only one booth at a time can be switched on to sound and vision. Once the button is pressed the view on the booth monitor changes from the general picture of the bank's hall to the teller's face in close up, and the sound channel is switched on to the booth by means of a footswitch which enables the teller to control the conversation.

The customer states what he wants and the teller asks him to put either his passbook or cheque into the special conveyor which brings it through to the banking hall. The book or cheque when received is inserted into a television viewer which sends the image of the cheque to the ledger department to verify the account and the customer's signature. While this is being done, the teller switches the booth monitor back to a general view of the banking hall and asks the customer to wait for a moment.

I knew I heard pop music! (T.V. Times)

If a second customer enters the other booth while the first customer is busy with his transaction, the teller can ask Customer Number One to hold on while he presses the black cancel button and then the appropriate button for the second booth. He will tell the Number Two Customer to wait until he has finished with the first one.

All this takes only a matter of seconds to carry out and while the second customer, who is under continuous observation, is waiting for attention, the transaction is completed with Customer Number One. As soon as the customer has finished, the teller bids him good morning, but before releasing the magnetic lock on the door of the booth, the teller checks, through the security monitor, that no suspicious characters are hanging about outside the booth. Should he see a suspicious character, he can warn the customer to wait a moment while security officers take steps to deal with the threat.

In addition, the bank has installed a 24-hour cash dispensing unit, operated by a special coded card, which will provide a customer with £10 any hour of the day or night. In the arcade of the branch, there is the usual night safe. Both these facilities are under constant surveillance by TV cameras, the pictures from which are transmitted by cable to a monitor and to a video tape recorder.

A spokesman for the Clydesdale Bank directorate said that if this prototype installation is successful, the system will be extended to other major branches throughout Scotland.

This new branch was described by Sir James Robertson, Chief Constable of Glasgow, as providing a notable service to the bank's customers, both from the point of view of convenience and security.

"It is an object lesson," he said, "to everyone in safeguarding the dispensing of cash. The bank is giving a better service to the public and at the same time denying the opportunity to any criminal to help himself to other people's money. Far too many crimes which the police investigate today display the most shocking disregard of the elementary principles of crime prevention." (Philips "Sound Plus Vision," October, 1969.)

DIGEST

ARE LASERS TOO EXPENSIVE FOR INDUSTRIAL USE?

The author of this article, Steve Liebman, suggests it is time to examine the role of the laser more closely, in the light of experience to date, which shows an apparent lack of interest by industry.

The concept of stimulated emission of coherent light was first achieved just 10 years ago, in 1960, but it was some two years later that the first laser was made to work. It was immediately hailed as having a fantastic future, but 1964 came along before anyone had actually found an application. Since then, lasers have been on the verge of a perpetual "breakthrough" when true commercial viability would be achieved.

Lasers can be likened to the pebbles on the beach. They come in all shapes, sizes and colours. Researchers have eagerly grasped each new possibility as it came along, with the result that there is a very wide range of gas and solid-state lasers on the market. Each has a staunch supporter convinced that his laser is the one that will be the "market buster." Because lasers are such fun to play with, they have made ideal research topics for universities. Much research and development has been carried out in educational establishments, so that a host of effects have been discovered, most of which appeared useful if only someone could think up a use.

The general feeling among those companies marketing and using lasers is that there is a great future in lasers and that the market will develop gradually in the form of systems, and not components. It appears, however, that each company predicts different growth areas, with apparently very little hard commercial information to back up their predictions.

It is safe to say that lasers have not made the grade commercially in Britain. Industry seems to be holding back to see what will happen, with the result that the capital that must be invested in lasers is being withheld at present.

Despite present hesitations, there is no doubt that lasers are here to stay. Output powers will rise, prices will fall, and when these developments occur, the laser may become commercially viable.

The dawn of 1970 sees lasers with a heritage of a multitude of possible applications, and a market that is still not ready to receive them. Matching the very diverse range of lasers is the very diverse range of manufacturers, all trying to carve out a corner of the market for themselves.

Last summer there were about 20 organisations marketing lasers in the U.K., of which some were importing from the United States. Others were American companies manufacturing in Britain, while the remainder were wholly British companies.

Since then, about five organisations have ceased trading in lasers because the market was unable to support all of them, and it appeared that the market growth was too small to warrant the maintenance of their operations. These companies were G. and E. Bradley, Union Carbide, Claude Lyons, and Spectra Physics.

The last of these is worthy of particular mention, since the U.S. parent company set up a factory in Glenrothes as a result of market trends in America. They were exporting about 30 per cent of their production capacity to Europe, but it proved to be a mistake to set up shop in England. Spectra Physics are running down their Glenrothes plant and will now quote only on American imports.

While there is an obvious redundancy of manufacturers, most seem to think of themselves as the market leaders in a market where, with very few exceptions, orders for laser heads or laser systems are numbered in ones, twos and threes.

One of the exceptions is Barr and Stroud Ltd., of Glasgow, who claim to have been awarded a military contract valued at over £1 million for tank range finders.

The uses of lasers can be broken down into about five broad categories, all partly overlapping. These are communications, metrology, holography, data processing and machining.

Communications applications of lasers have turned out to be rather impracticable, mainly due to transmission attenuation problems. Modulation of the light beams is now no problem, but the day when several thousand TV channels will be piped down one laser beam is perhaps 10 years away.

Line-of-sight atmospheric transmission is no good because of the high attenuation, and a rigid optical system would be terribly expensive. The only other system currently available uses fibre optics. Again, attenuation problems destroy its viability until such time as a breakthrough occurs in the manufacture of glass fibres. The only promising use of laser communications is in computers for very fast, high-capacity data transmission over short distances.

Up until very recently, the largest part of the laser market was to be found in the universities. Lasers were sold for pure research into lasers and materials, and for Raman spectroscopy (akin to UV or IR spectroscopy). This market is now reaching saturation.

Currently the greatest number of applications lies in metrology, mainly due to the relative simplicity of some of the systems. Of these the simplest is alignment equipment which has been designed for lining up alternators, ship docking and so on. Many of the manufacturers market laser surveying equipment, such as theodolites. These have been found to be very useful for surveying large civil engineering works, for example, tunnels, bridges and motorways.

According to one company, many more laser surveying systems are sold in the U.S., largely because the cost of labour is so high that employers are prepared to invest money in any labour-saving device. The reaction in the U.K. tends to be that it is cheap enough to employ two men for conventional surveying, especially since the labourer who holds the pole can also make the tea.

Interferometry is employed for very accurate displacement measurements in the machine-tool industry. Laser Associates claim to be able to measure distances as little as 0.05in over a total distance of 450 feet.

According to Pilkingon Perkin-Elmer, this field will grow rapidly in the near future, and the American market will see laser interferometers incorporated into machine tools within one year — and perhaps some time after that in the U.K. Again, the problem of capital investment appears to be a prime cause of slow progress in Britain.

Another kind of "interferometry" is the range of burglar alarms and intrusion detectors made by Photain Controls, where a laser beam and photodiode are used in a conventional manner, except that much greater distances can be covered with a laser than with normal "rays." These systems are apparently not too successful because they are both expensive and difficult to set up correctly.

Laser rangefinders are gaining acceptance, particularly in the military field, and also for work on air pollution.

A recent development in America is the use of Erbium-YAG (erbium-yttrium aluminium garnet) lasers, which lase at a frequency that is almost harmless to the human eye (at 1.5 microns, a frequency that is highly attenuated by the eyeball itself). The importance for military rangefinders is that they can then be widely used without the danger of causing accidental blindness.

Of all the uses, machining has received the most publicity and, despite the apparent wide use in this field lasers are not yet economically viable in most industrial applications. They are truly successful only for those jobs that cannot be done by any other means.

Where very fine holes are required in extremely hard materials to a depth many times the hole diameter, the laser comes into its own. Laser Associates are very active in this field, marketing a range of drillers, including a numerically controlled machine.

Lasers have been used successfully for many fine cutting, drilling and welding jobs, but orders still only occur for ones and twos.

(Continued on page 29.)

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U.K. POST OFFICE RE-ORGANISES ITS CONSUMER RECORDS

From the U.K. comes news of two new developments in the Post Office involving the use of computers. The first is the computerisation of the telephone directory records; the second is production and control of telephone credit cards by computer.

The completely integrated computer printing process, developed jointly by the Post Office and Her Majesty's Stationery Office, is said to be the most advanced method of producing telephone directories in the world. The method employs (a) computers to select, arrange, and edit directory entries, and (b) modern high-speed photo-composing processes for setting directory information. From photo-polymer printing plates produced by the system, huge rotary presses print the pages, and the job is completed by automatic gatherer-binder-trimmer machines.

The stage-by-stage system begins in the Post Office with telecommunications staff entering customers' directory entries on cards in a ready form for punching and computer processing.

The Post Office's National Data Processing Service (NDPS) gathers the information daily from telephone managers' offices all over the country at its Leeds computer centre. When the time comes to produce a new edition of a telephone directory the complete list of numbers with names and addresses and information on how each should be printed is selected by this computer and recorded on magnetic tape. This is sent to the Stationery Office computer at Norwich, which edits the information, converts it to digital form, and records it on punched paper tape with typographical instructions.

From this tape the Stationery Office plant at Gateshead automatically produces an alphabetical telephone directory, page by page, on a photo-composing machine at a rate of four minutes a page. The pages are photographed nine at a time and from the negative are produced plastic covered lightweight wrap-around plates. The plates are directly mounted on rotary presses that can run off 40,000 72-page directory sections in an hour. The sections are brought together to make the full directories on a machine that automatically gathers and trims them, and binds them in their cover.

The new method enables the Post Office and Stationery Office to prepare a directory from scratch ready for printing in 45 working hours — a fraction of the time previously taken in working from stored metal type and making the necessary 25 per cent amendments and alterations that are required every year.

At first, the yellow pages of the classified section will continue to be printed separately and brought together with the alphabetical section at the binding stage. But the Post Office is planning to include classified directory production in the new method by 1973.

The new method will meet the growing problem of having to produce more and bigger directories year after year as the telephone system continues its rapid expansion. For every 10 per cent increase in the total of telephone subscribers 20 per cent more paper is wanted for directories.

Today there are 22 million copies of telephone directories issued in the United Kingdom every year. These use 25,000 tons of paper. One complete set of directories contains 30,000 pages and 7½ million entries.

By 1975 the number of directories issued is expected to rise above 33-million, using 45,000 tons of paper. One complete set will then have about 45,000 pages containing 11 million entries.

The Post Office will shortly begin to use the computer system to keep every directory inquiry operator constantly provided with the very latest changes to the lists of telephone numbers which they hold.

The telephone credit card system, launched in 1960, today caters for 165,000 card-holders. For about 50c a quarter the renter has a number to quote to telephone operators on which he can make unlimited calls from any telephone in Britain and back to the U.K. from 92 countries overseas. Calls are charged to the renter's account at operator rates and there is an additional fee of 7c on each inland call. These telephone credit cards are now produced by computer.

The CCITT (137-nation International Consultative Committee for Telephones and Telegraphs) introduced on January 1 a new international credit-card scheme that will eventually enable businessmen and tourists abroad to make credit calls home from even more countries.

Taking advantage of the new arrangements, the Post Office has transferred production and control of its credit cards to a computer. This reduces the cost of running the credit system and will help to hold down charges.

Credit card numbers expire on December 31 and are changed each year. First credit cards to be run on the computer — an ICL 326 at the Derby computer centre of the National Data Processing Service — were those for 1970, changing over from 1969. Details of 165,000 card-renters were fed into the computer which calculated a new number and printed out the cards. Calls made with credit cards are being fully integrated into the preparation of bills by computer.

Previously, new credit cards have been issued at the turn of the year and the Post Office has allowed a month's grace during which renters who had not received new cards might continue to use their old numbers. Under the CCITT scheme this is no longer possible, so the Post Office will in future issue the cards well before the end of the year.

EXPENSIVE LASERS . . . continued from page 27

Interesting work has been carried out using lasers in the preparation of integrated circuit masks. They have been used for trimming thick and thin film components with great success. One particular advantage here is that the components can be encapsulated in a clear material — a process that changes the values of the components —and trimmed afterward. Machining operations can be carried out on workpieces housed in a vacuum chamber, again with obvious advantages.

Another form of fine machining is found in medicine, stitching or spot-welding detached retinas in the eye. This application received a lot of attention a few years ago and has now become an accepted technique.

While all these systems appear to be very useful, they all have one major drawback — the price. The high investment required for laser machining systems appears nearly to preclude them as far as industry is concerned.

Holography has been said to have a very bright future, with many applications in industry, but all the signs at present seem to point toward he development of lots of nice ideas, very few of which will ever become commercially acceptable.

Stress measurements come neatly into this category. Several people believe that lasers will be used in factories for production-line stress testing, but that day is many years off.

However, holography may become important for computers, since this phenomena can be used to store vast quantities of information in certain types of crystal, and, of course, on photographic plates.

Much development effort is exerted in this field, but as yet it is still some considerable way from being a practical proposition.

RCA have developed a novel laser system using holograms. They have recorded TV pictures on to film using a scanned laser. The pictures can be reproduced bv scanning the holograms with another laser.

Data processing involving lasers ranges from data storage and data transmission to the use of lasers as very fast logic elements. Very little work is being done on this last facet in the West. ("Electronics Weekly," 21/1/70.)

SCIENTIFIC AND INDUSTRIAL NEWS

Model competition

The Institute of Applied Science of Victoria has announced a model making competition as part of the celebrations to mark the centenary of its opening in 1870 as the Industrial and Technological Museum. Entries are invited for three-dimensional models of any objects within the field of applied science. Models may represent an object which was a milestone in technical history, or represent a modern concept. An entry may take the form of a series of minor models which represents historical development of one theme or significant variations in one theme. Entrants are required to supply a declaration that all constructional work was carried out without the assistance of any other person. Ready-to-assemble kits are not admissable in the contest.

The competition is divided into three sections: an open section for all amateur model makers with a prize of $500; an apprentice section for apprentices and university students with a prize of $250; a junior section for entrants under 18 years of age with a prize of $100. There is no entry fee, but all entries must be covered by an entry form which must be lodged with the institute not later than July 31, 1970. Completed models are to be delivered to the institute's store not later than August 15, 1970. Entry forms and further details may be obtained from the Institute of Applied Science of Victoria, 304-328 Swanston Street, Melbourne, 3000.

Tasmanian communications

Communications projects valued at several million dollars were announced recently by the Postmaster-General. One of the largest projects, valued at $430,000, was the installation between Smithton and King Island of a broadband radio system to provide television relay facilities to King Island together with a large number of additional telephone channels. The TV relay link would be provided to coincide with the proposed completion of a National television transmitting station on Gentle Annie. The King Island station will take its programs from the Launceston station. The programs will be received "off-air" at Smithton and relayed over the broadband system via Three Hummocks Island.

In addition, work has been completed or is in progress on the installation of multichannel telephone systems between a number of Tasmanian centres. These include: a 600-channel system between Burnie and Queenstown and a 120-channel system between Mt. Read and Rosebery, both of which opened earlier this year; a 300-channel system between Hobart and Geeveston, and a 960-channel system between Hobart and Westerway, both of which are due to be in operation by October, 1970; a 300-channel system between Hobart and Triabunna which should be completed by the end of 1971. Similar systems were planned between Burnie and Smithton, and between Launceston and Scottsdale.

Common user data network

The Post Office has awarded a $4.4 million contract to the Univac Division of Sperry Rand Australia Ltd. for the establishment of a nationwide common user data network. Computer-based switching will be established in Sydney, Melbourne, Brisbane, Adelaide and Perth. Establishment of the initial network will be progressive during 1971 and 1972, and the network will be capable of expansion to meet the requirements of additional customers.

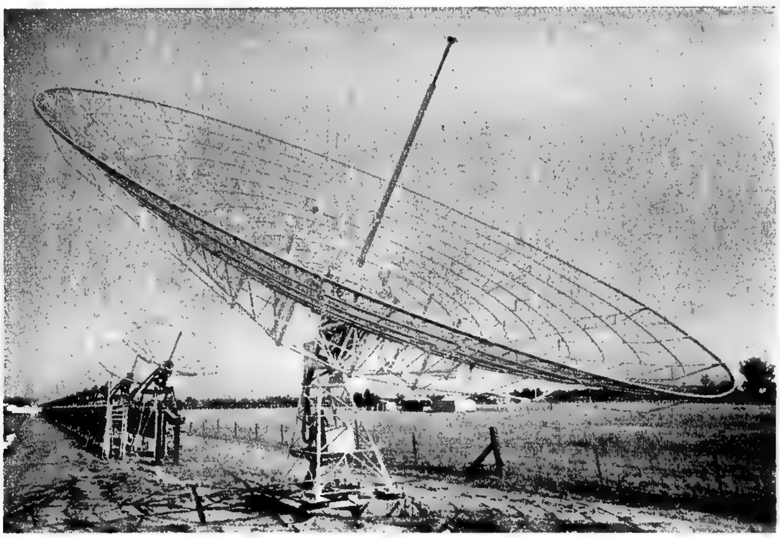
The network will be flexible to meet the variety of communications needs of organisations using computers, and will be able to handle telegraph-like messages of the type already in use within organisations having full-time leased networks. Users will share a network with extensive facilities and load-carrying capacity, while at the same time operating as if they had their own private network. Each organisation will be assured of complete security without intrusion from other users. Switching computers and associated equipment will be duplicated to ensure an extremely reliable service.

Adjustable glasses

The British National Institute for Medical Research has developed spectacles which can be adjusted by the user to focus on objects near or far. Called variable refraction spectacles, they have a circular patch in the middle of each lens and a small sliding attachment on one side-arm. To use the spectacles, the user looks at an object and moves the slide until the object comes into focus.

In the new glasses, the lenses are hollow. The front is an ordinary spectacle lens, the back is a sheet of very thin glass, and the middle is a clear plastic material called polyvinyl butyral which sticks to glass. A hydraulic system is used to change the shape of the lenses in much the same way as

Sydney's radiotelescope



A team of electrical engineers from Sydney University, under the leadership of radio-astronomer Professor W. N. Christiansen, is renovating a 15-year-old antenna array at Fleurs, 30 miles west of Sydney. The cross-shaped telescope consists of 64 19ft-diameter dishes in two rows, forming a compound interferometer, originally used by the C.S.I.R.O. to make the first daily maps of the sun.

Four 45ft-diameter dishes have been added to the ends of the arms, and racks of complex electronic equipment have been installed. The circuitry combines the 68 antennae into the equivalent of one giant dish. One arm of the interferometer is eqivalent to a dish one mile in diameter.

The Fleurs radio telescope will be used for mapping a small area of the sky with a resolution of 40 seconds of arc. The two arms will be used for eight hours each on consecutive nights to produce a detailed map of an area one degree in diameter.

One arm of the Fleurs radio telescope, with a 45ft dish in the foreground.

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Integrated Circuits

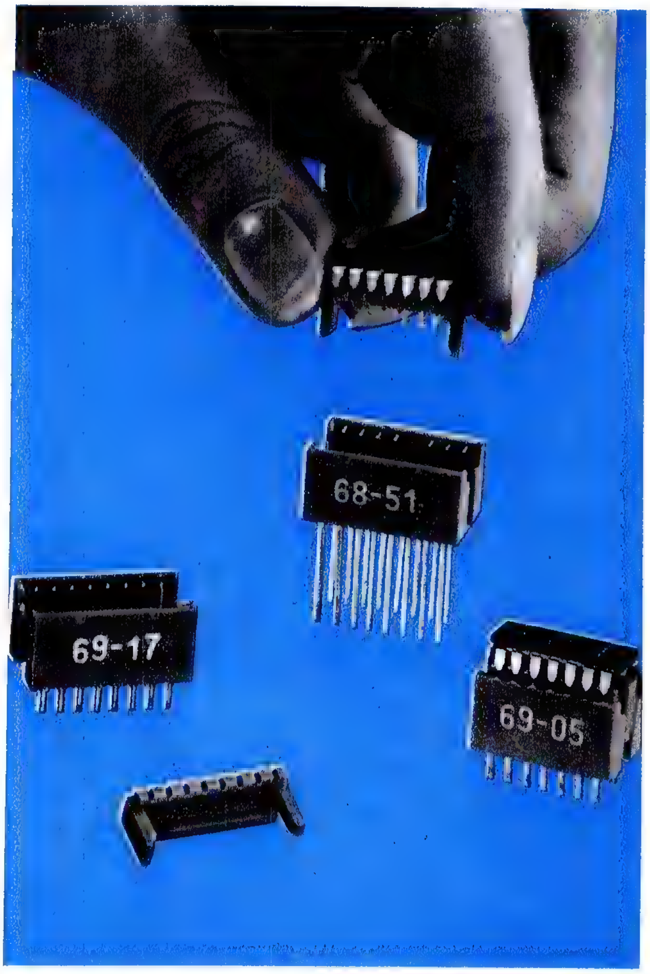
Dual In-Line Wedge Connector

The Dual in-line connector developed by AMP offers a plug-in facility for dual-in-line packages plus ease of servicing and changing of circuit functions.

The connector consists of two parts, a carrier on which the dual-in-line package is applied and a connector housing into which the carrier is plugged. The package is fixed to the carrier by first sliding the leads into slots and then folding them inwards and back on themselves. The carrier is plugged into the connector housing by wedging it down the tapered contact blades in the housing. This method of connection obviates any axial thrust on the leads — a frequent cause of damage to dual-in-line package and generates a high contact force thus it is not necessary to use exotic platings to ensure good contact.

The facility for applying either solder or wire wrap terminations to the rear posts of the housing contacts plus the fact that the connector occupies only 0,5sq.in of panel space means that the dual-in-line connector represents an economical alternative to multi-layer printed circuit boards.

In addition to the normal connector for dual-in-line packages, this connector with a slightly different insert can be used as a tape cable connector. For full details of this application please consult AMP.



	With wrap type posts	With solder tabs	Spare carrier
	Part number	Part number	Part number
14-way Dual-In-Line Package	151555	151556	151558
16-way Dual-In-Line Package	151578	151579	151575

the human eye is focussed. When the slide is pushed forward, a transparent liquid is forced into a circular hole in the plastic part, and the thin back glass bends under the pressure. The movement is very small, but sufficient to provide the range of focus required by most people with faulty vision.

Patents Act

The new Patents Act, which came into force at the beginning of this year, makes it easier for an inventor with a commercially successful invention to obtain quicker protection, instead of the inevitable long wait under the old Act. Under the previous system, every application was examined whether potentially successful or not. The new Act requires inventors to reassess the potential value of their inventions before the Patents Office begins examination of the application. A patent will not be examined unless an applicant specifically requests it. The applicant has to make a decision each year whether he ought to keep his application current until it comes up for examination.

Also, under the new system it is possible for an application to be examined out of turn if a request is made to the Commissioner of Patents. A higher fee is charged for this type of examination, but it has the advantage of patents being available for an invention much earlier. As 80 to 85 per cent of all complete specifications being lodged come from overseas, there was no way under the old Act for an Australian to get priority over foreign applicants. Under the new system, however, an Australian applicant who wants to obtain a patent for the purpose of gaining finance no longer has to wait his turn in the queue.

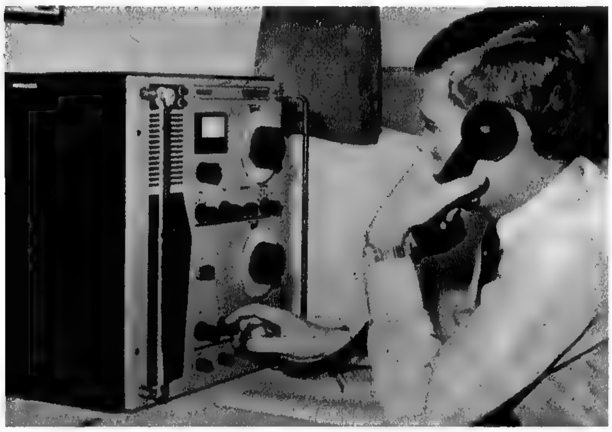
Agreement on frequencies

Following the signing of a new agreement between Australia and New Zealand on the use of medium frequencies, improvements in radio broadcasting services to some areas of Australia were foreshadowed in a statement from the Postmaster-General. Under international regulations, only 108 frequencies are available for domestic radio broadcasts in the MW band.

Australia and New Zealand are equally entitled to use all of these frequenceis but close co-operation is necessary because of the proximity of the two countries and the fact that broadcast waves travel for long distances at night. The new agreement, which replaces one signed in 1950, takes note of techniques such as directional aerials, which make possible closer sharing of frequencies.

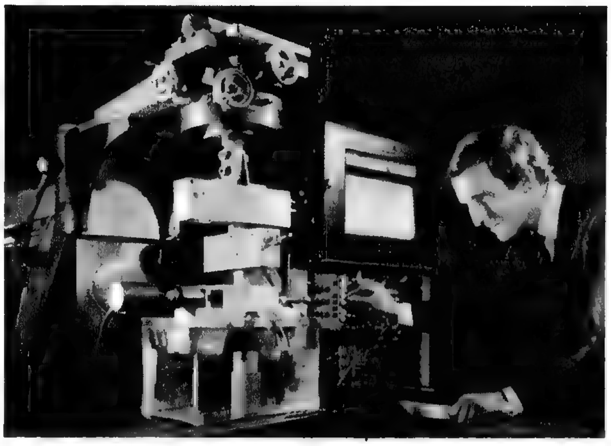
The Australian Broadcasting Control Board was now in a position to plan for improving the coverage of some existing stations and for providing a service where there are deficiencies at present, the Minister added. However, it was not practicable at this stage to disclose the areas where improvements would be made. This information would be made available as planning proceeded.

SSB radiotelephone



A prototype "Falkland" radiotelephone. It is the first in a range of HF SSB radiotelephones to be developed under an agreement between Kelvin Hughes and Racal. Racal will design and manufacture the equipment which Kelvin Hughes will market world-wide for commercial marine purposes. Racal has exclusive right of sales to armed Services. (Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, N.S.W. 2113.)

Automated goniometer



This automated ultrasonic goniometer was developed in the Nondestructive Testing Centre of the U.K. Atomic Energy Authority at Harwell. The device can be used to monitor the surface elastic constants of a wide range of materials and is currently being applied to the study of composite materials and to an understanding of surface adhesion.

Sonar research

Scientists from the Lockheed Ocean Laboratory in San Diego are conducting underwater acoustic experiments about 300 miles off the coasts of California and Florida. Sponsored by the U.S. Naval Air Development Centre, Lockheed is seeking to improve anti-submarine warfare detection systems.

The oceanographers are measuring the effect of ducting and bottom bounce on underwater sound with the following objects: to give greater accuracy to detection range prediction methods; to predict the performance of present and planned sonar systems; to establish criteria for new sonar systems; and to give better understanding of the physics of underwater acoustics.

In the experiments one ship tows a "pinging" sound device at different depths to simulate a submarine, while another vessel some distance away receives the signals. Sound waves are also created by aircraft dropping explosive charges into the sea. The studies include sea conditions that can distort, scatter or absorb sonar echoes from a lurking submarine. These factors include ocean temperature, salinity, pressure, currents, internal waves, and marine animals.

Ocean technology

In 1966, the Institution of Electronic and Radio Engineers, in the U.K., organised the first conference to be held in Europe on "Electronic Engineering in Oceanography." Many of the developments which were discussed at that conference have found applications and the discipline of "Ocean Technology" has become established. To provide an opportunity for assessing some of the new techniques which are coming forward, the I.E.R.E. is to hold a second conference — "Electronic Engineering in Ocean Technology." The main theme of the conference will be "The gathering, transmission, processing and display of information from the sea."

It will be held at the University College of Swansea, Glamorganshire, South Wales, from September 21 to 24, 1970, and the I.E.R.E. is being joined by the Institute of Electrical Engineers as co-sponsor. The organising committee, under the chairmanship of Professor D. G. Tucker, includes members of the two sponsoring institutions drawn from organisations concerned with ocean technology. Paper to be presented will describe new or unpublished work in the following fields: sensors and recording; communications and telemetering; signal and data processing; display systems and power sources.

Further information and registration forms for the conference are available from the Conference Registrar, Institution of Electronic and Radio Engineers, 9 Bedford Square, London W.C. 1, England.

Digital exchange

A year's operation of a digital tandem telephone exchange in London has shown that PCM switching of speech channels is feasible, giving improved reliability. The experimental digital tandem exchange was installed for field trials in the Empress public telephone exchange building in West Kensington in September, 1968, and has operated successfully on live traffic ever since. (See "Electronics Australia," November, 1968, page 25.) Measurement of the quality of service indicates that equipment of this type will lead to a considerable improvement over the existing electromechanical exchanges, the number of calls lost being less than 0.1 per cent. The tandem exchange handles approximately 3000 calls per day; nearly one million connections have now been completed.

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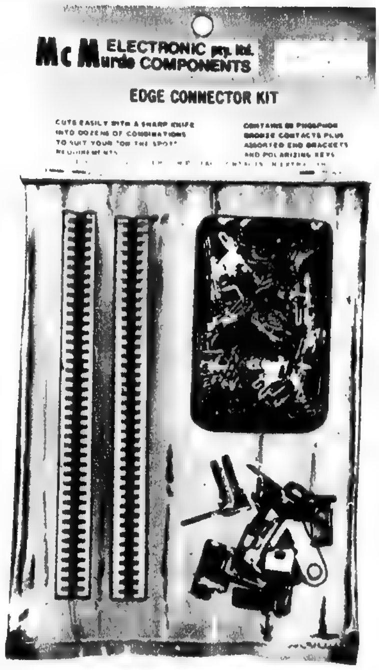

Kit Price Gold, $3.75. Tintillate, $2.75. Available from your local wholesaler.

Modules can be made up with any number of contacts ● Contact arrangement to suit customer requirements ● Lowest possible cost. Available in kit form for prototype design projects ● Can be cut to any length with a sharp knife ● Special charts supplied on request to simplify ordering ● Polarising Key easily inserted by removing contact ● Available with P.C. or wiring tails.

Moulding	Polypropylene (red)
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P.C. board thickness	1/16"
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OVERSEAS STUDY COURSE

Young electronics engineers and scientists have an opportunity to further their studies through an international scheme of postgraduate study. The scheme is operated by the Philips Institute of Technological Studies, set up in 1957 by the international Philips electronics organisation. It is the Philips International Institute (P.I.I.) scheme, intended for non-employees of Philips throughout the world.

The P.I.I. scheme is designed to provide young graduates under 30 with one year of post-graduate study in the various branches of science and technology which come within the ambit of Philips' activities. The scheme has the twin objectives of: improving the students' general knowledge in modern electronic techniques and disciplines; and providing more specialised training in one of the main fields of applied electronics. It includes free travel, accommodation, and study programs, plus out-of-pocket expenses, free medical schemes, etc., and offers students the opportunity to obtain the degree of Master of Electronic Engineering at the completion of the course.

Students accepted in the P.I.I., which is located at Philips' world headquarters in Eindhoven in the Netherlands, undertake private theoretical and experimental studies within the Institute, attend lectures by the company's experts, and are offered the opportunity to obtain practical experience in the company's laboratories. The program of studies is individual and every effort is made to keep lectures and practical work periods in accordance with each student's own preferences.

The number of places for the course is limited to 30 each year in order to guarantee good personal contact between staff and students, and the academic standards of applicants for the course must consequently be high. The 1970-71 course commences in the last week of September, 1970, and will specialise in control and industrial electronics. In 1971-72 and 1972-73, the main subjects will be communication techniques and digital techniques respectively.

Further information about the Institute, and application forms for the 1970-71 courses, are obtainable in Australia from Mr H. J. Brown, Technical Director, Philips Industries Ltd., 69-79 Clarence Street, Sydney, 2000. Interested persons should contact Mr Brown immediately because applications for this course must be received by the Institute in Eindhoven before May 31, 1970.

Darwin television

A contract, valued at nearly $350,000, has been awarded to Harris James Pty. Ltd. for the construction of television studios at Darwin for the Australian Broadcasting Commission. The contract is due for completion by February, 1971, and television broadcasting is expected to begin in June, 1971. The new building will be on a site adjoining the existing A.B.C. radio studios and connected by a covered way.

Quantam expansion

Qantas Airways Ltd. has ordered equipment to the value of $17.7 million to expand its computer complex, Quantam. Advanced equipment worth $13.5 million will be purchased from IBM, Honeywell and Raytheon. In addition, $4.2 million will be spent on essential support equipment services and the fitting of reservations and booking offices throughout the world to accommodate the new equipment. The expansion is geared to the introduction of four Boeing 747B aircraft in 1971 and the anticipated increase in passenger bookings. It is also based on estimates that the airline will be more than three times its present size by 1980.

Light control

Marconi Broadcasting Division have introduced a new "Auto-Light" unit for Marconi telecine cameras. The unit performs automatically the adjustments necessary when film and slides of varying density are televised. These adjustments are to maintain correct black and white levels in the transmitted signal and are particularly important when new films are shown, as these may have been made under widely varying exposure conditions. The Auto-Light unit frees the camera operator from continual manual correction of picture whites and blacks, and in the case of colour film it enables him to devote his full attention to the important task of maintaining colour balance. The Auto-Light unit has a faster response to changing film density than a human operator, and results in a more consistent picture quality for the viewer.

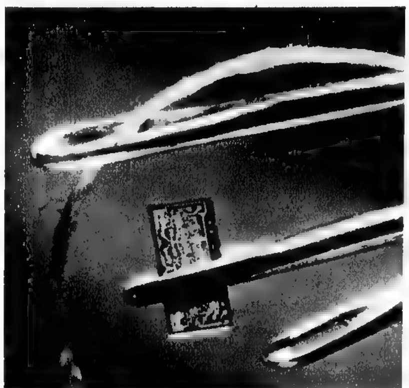
Computer training

The Canberra College of Advanced Education has purchased a Burroughs B5500 computer system to be installed in the college's new building in Belconnen, A.C.T. Training in the use of computing equipment is an expanding responsibility of the college, which now offers a three-year full-time course in computing studies. The college has also agreed to collaborate with the Commonwealth Public Service Board in running courses for programmers-in-training within the Service. Many students at the college specialising in other subjects will also be introduced to computing as an essential element in their courses. The facilities of the computing system will be made available to Government Departments and other users on a batch and/or time-sharing basis.

Solid-state lights

Bell Telephone Laboratories in the U.S.A. have developed new phosphors employing rare earth elements in crystals. When crystals containing erbium or holmmium were painted on infra-red emitting gallium arsenide diodes, a green light was produced. A blue light was produced when thalium was used. With one of the phosphors, the colour shifted from green at low-power levels, through yellow, off-white and orange as the power was increased to a brilliant red at high-power levels. The new phosphors are said to be much more efficient than earlier phosphors which produce visible radiation when excited by radiation of shorter wavelength. (See also "Electroluminescence," in the March, 1970, issue of "Electronics Australia").

Miniature circuit



An unencapsulated IC decade counter, containing more than 120 components, in the eye of an ordinary sewing needle. For comparison, a length of sewing cotton has been threaded through a similar needle. Commissioned by Mullard Ltd., of the U.K., to illustrate the extremely small size of microcircuits, the photograph has earned for Mullard a "Financial Times" photography award.

New style combat vehicles

Lockheed Missiles and Space Co. has built the first of a new generation of combat vehicles for the U.S. Army, based on an original Lockheed design, known as the Twister. The Army has designated its new armoured fighting vehicle the XM808. The Twister is a two-bodied vehicle with the bodies joined by a flexible yoke. An engine in each body drives four wheels, giving the complete vehicle an eight-wheel drive. The wheels on the front body are independently suspended, while the rear wheels work in pairs on powered walking beams.

The combination of suspension, positive steering, and flexibility between the two bodies enables a Twister to cross rough terrain at much higher speeds than conventional tracked or wheeled fighting vehicles. It can sustain rapid movement in hazardous terrain because the suspension and body flexibility protect the crew from the jolt and shock of high-speed operation. The same features keep all eight wheels on the ground and driving, no matter how irregular the terrain. During tests, the new Army vehicles climbed a three-foot wall, and drove up a 60 per cent grade at more than 11 m.p.h.

An XM808 on the Lockheed test course in the Santa Cruz Mountains.

MARCONI ELLIOTT COMPUTER SYSTEMS

Marconi-Elliott Computer Systems Ltd., U.K., has selected for its house-style the computer typeface developed at the British National Physical Laboratory by Timothy Epps. (See "Electronics Australia," January, 1970, page 31.) The illustration shows the typeface on the company's letterhead.

Hot-running motor

The General Electric Co. of the U.S.A. has run an electric motor at over 1400°F through the use of new conductor materials. The previous highest temperature recorded by the company was 900°F. The synchronous motor used in the tests is similar to an ordinary 110V clock motor except that the field windings are made from wire fabricated from a silver-palladium alloy coated with nickel. The problem of high-temperature insulation is solved because the nickel oxidises in air at high temperatures to form an excellent insulator. The wire has been tested and operated in air at temperatures up to 2200°F without any deterioration from repeated thermal cycling.

Analysing star images

A "Galaxy" measuring machine, taken into service recently at the Royal Observatory, Edinburgh, Scotland, is capable of detecting and analysing 1,000 star images in one hour. Astronomers will be able to make detailed analyses of the photographs taken through the observatory's 16in telescope, and so determine the exact location, distance and brightness of nearly every star image.

The operation of Galaxy depends on the scanning of the photographic plates with one of two focused electron beams, and a photodetector placed under the plates. First a rough scan is made (with a spot size of 16 microns) to locate all star images, and the information is stored on paper tape. This tape is then fed into another part of the machine, and individul star images are selected in turn for analysis using a spot size of only one micron in diameter.

Nelcon '70

The New Zealand National Electronics Convention, Nelcon '70, will be held at the School of Engineering, University of Auckland, on August 25-28, 1970. The convention will include general discussions and institute meetings, as well as social functions, trade exhibitions, films, symposia and a number of different streams of papers on various subjects. Papers will be presented under the following broad headings: components and instruments; applied electronics; research electronics; communications; computer systems, applications and data handling; electronics in health; micro-electronics; colour television; satellite communications.

The enrolment fee is $10 ($7 if paid by May 1, 1970). Full details may be obtained from the Secretariat, Nelcon '70, P.O. Box 3266, Auckland, New Zealand.

U.S. trade centre

An exhibition of U.S. data communication and graphic data systems will be held in Sydney from June 29 to July 3, 1970, to mark the opening of the first U.S. trade centre to be established in Australia. A symposium on "Computers in the Seventies" will be conducted at the same time as the exhibition. The Sydney trade centre is being established by the U.S. Department of Commerce in co-operation with the U.S. Embassy and the American Consulate-General in Sydney.

Philippines colour TV

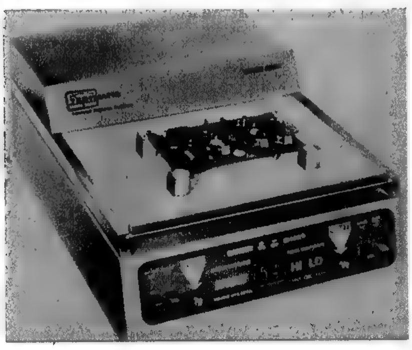
Two Manila television stations will become the first in the Philippines to convert to 100 per cent colour programming, following the purchase of RCA colour equipment valued at $700,000. The stations are owned by the ABS-CBN network, which also operates four television stations outside the Manila area. The purchase includes five colour TV cameras and three colour TV film origination systems.

Commercial broadcasting

A licence to operate a commercial broadcasting station at Alice Springs has been granted to Alice Springs Commercial Broadcasters Pty. Ltd. on the recommendation of the Australian Broadcasting Control Board. The grant of the licence is subject to compliance with certain conditions which have been communicated to the applicant.

Production fault-finding

The Testmatic TM60, an automatic test set developed by Wayne Kerr Ltd., automatically locates faults in both simple and complex printed circuits and electronic sub-assemblies. The instrument can be used anywhere in a production line and makes 59 measurements in four seconds with an accuracy of 1 per cent. The results are shown as a number to indicate the defective test point, accompanied by "OK" (correct), "HI" (high voltage fault) or "LO" (low voltage fault).



The Testmatic TM60.

Programming is done with a separate programming and test panel, which also acts as the test jig on which the circuit or sub-assembly under test is mounted. Intermittent faults can be detected by switching the instrument to repeat the test program continuously, in which case an audible warning is given when a fault arises. The programming and test panel is made up from a number of standardised component parts which are supplied as software to any user of the Testmatic. The test supply voltages are positive or negative between 5, and 18V. The minimum voltage checked by the instrument is 100mV. (Wayne Kerr Ltd., New Malden, Surrey, England.)

KENWOOD's Ideal The KL-880 Speaker And The KA-6000 Stereo Amplifier

SPEAKER SYSTEM
KL-880

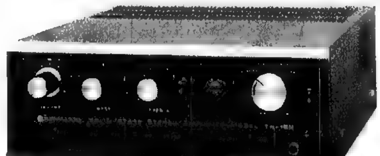
HEAD PHONE
HS-3

Perfect performance mates—that's KENWOOD's KL-880 4-way, 5-speaker system and the KA-6000 stereo amplifier.
Sound as it really is—not as it almost is. That's an extra you get because the KL-880 has a 15-inch free-edge woofer, a 5-inch cone type midrange and horn type high midrange squawkers.
Add two horn type tweeters and KENWOOD provides you with amazing ultra-angle treble dispersion.

The KA-6000 is a power-packed 180-watt stereo amplifier that drives life into Hi-Fi speakers of lowest possible efficiency. Combined with the KL-880 they're an unbeatable stereo team.
There's wide power bandwidth of 10 Hz to 50,000 Hz with low-low IM distortion. And the KA-6000 has exclusive low level phono inputs for low level output phono cartridges of 2 mV, 0.5 mV or 0.05 mV.
For personal, exclusive enjoyment there's

120-WATT SOLID STATE STEREO AMPLIFIER KA-4000

* The wide power bandwidth of 13 Hz to 30,000 Hz with very low IM distortion.
* Lever type-20 dB muting switch of quick response for momentary quiteness during telephone call, etc.
* Dimensions: 16-5/16"(W), 5-5/32"(H), 11-1/32"(H)



40-WATT SOLID STATE STEREO AMPLIFIER TK-150U

* 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
* Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
* Dimensions: 10-1/4"(W), 4-1/8"(H), 9-3/8"(D)

60-WATT SOLID STATE STEREO AMPLIFIER TK-250U

* 2 sets of stereo speaker terminals and front panel speaker selector switch.
* Dimensions: 13"(W), 4-1/8"(H), 9-15/16"(D)

Connection: System

180-WATT SOLID STATE STEREO AMPLIFIER KA-6000

the HS-3 headphone accessory.
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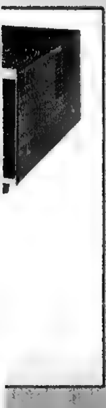

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THE DEVELOPMENT OF

Systeme Internationale was set up by international agreement in 1875 by the Convention of the Metre as the system of units to be used for measurements in countries using the metric system. The recent announcement that Australia will convert to metric measurement in the foreseeable future gives added interest to this article.

By L. C. Debnam

In Science and Engineering many variables occur, and most of these have to be measured. In electrical work measurements have to be made of voltages, current, power, energy, temperature, magnetic induction, capacitance, resistance, frequency and many other variable parameters. Many of these variables are related and need not be directly measured as they may be determined from other factors. For example if a resistor has a certain (measurable) current flowing through it when a definite voltage is applied across it the resistance may be expressed by the equation

$$\text{Resistance} = \frac{\text{applied voltage}}{\text{current flowing}}$$

Early in the nineteenth century the mathematician Karl Friedrich Gauss (after whom the c.g.s. unit of magnetic induction is named) showed that similar reasoning could be applied to all mechanical phenomena and that by use of such equations all could be expressed in terms of three fundamental quantities or "dimensions," length (L), mass (M), and time (T). Velocity is simply a measure of the distance travelled divided by the time taken to travel that distance and can be expressed as

$$\text{velocity} = \frac{\text{distance}}{\text{time}}$$

and as distance is simply a length this may be expressed in terms of dimensions as

$$\text{velocity} \leftrightarrow \frac{L}{T} = LT^{-1}$$

where the symbol $\leftrightarrow$ is used to mean "has the dimension of." Similarly acceleration is rate of change of velocity or

$$\text{acceleration} = \frac{\text{change of velocity}}{\text{time to change velocity}}$$

which may be expressed dimensionally as

$$\text{acceleration} \leftrightarrow \frac{L/T}{T} = \frac{L}{T^2} = LT^{-2}$$

Newton's second law of motion may be expressed mathematically as

$$\text{Force} = \text{mass} \times \text{acceleration}$$

or dimensionally in the form

$$\text{Force} \leftrightarrow MLT^{-2}$$

Other mechanical quantities may be expressed in terms of the fundamental dimensions M, L and T as in Table 1. Note in this table that "area" has dimensions of L^2, i.e., it is the product of two lengths, as "width" or "height" are simply different expressions of length.

In 1822 another mathematician, Jean Baptiste Fourier, pointed out that for mechanical equations to make sense the same dimensions must occur on both sides of an equation and an expression such as

$$1 \text{ day} = 3 \text{ miles}$$

(dimensionally T = L) is absurd, but an expression such as

Energy = mass times velocity squared,

although it may not be correct is not completely idiotic.

In 1905 Einstein showed that this is correct if the velocity concerned is the velocity of light in a vacuum. Similarly only quantities with the same dimensions may be added or subtracted, as

"1 day + 2 hours"; (T + T)

makes sense but

"4 minutes + 5 yards"; (T + L)

is nonsensical.

Regardless of the names that the quantities have (i.e. their units) they can only be added if their dimensions are the same. It is quite reasonable to add 5 minutes to 2 hours, or 3cm to 6in if the dimensions are the same but difficult to add 1cm of capacitance (about 0.9pF) to 1cm of length even though both have the name "centimetre." The centimetre of capacitance is no longer generally used but is the capacitance of a sphere 1cm in diameter. It is occasionally encountered in early books on electricity.

Confusion also occurs in the use of the "pound" which may be pound-mass **(lbm)** or pound-weight **(lbwt)**. Mass is a measure of the inertia of a body and anywhere in the universe a mass of one pound will require the same force to accelerate it at the same rate but the weight is a force and is dependent on local conditions. One pound weight on Earth is the downward force (mass × acceleration due to gravity) exerted by a mass of one pound, and if that same mass were to be taken to the Moon it would have a weight of one sixth **lbwt** as the gravitational acceleration on the Moon is only one sixth of that on Earth, but the mass remains the same.

To avoid such confusion the "pound mass" has now been replaced by the name "slug" in the British Technical System of Units.

Dimensional Analysis (i.e., operations with dimensions) was used to handle mathematical operations in mechanics problems with great facility, but the concept of temperature (not heat, which is a form of energy) was puzzling as it was not related to anything else except an equally obscure "heat capacity." The problem was circumvented by William Thomson (later Lord Kelvin) who introduced the Absolute scale of temperature. Within three years of this, thermodynamics and mechanics were properly interrelated.

In 1861 William Thomson disturbed the complacency of the scientific world by suggesting to the British Association for the Advancement of Science that electricity and magnetism be incorporated into the structure of mechanics and fundamental quantities. The Association unfortunately had based their system on some earlier suggestions of Karl Gauss and Wilhelm Eduard Weber.

The reasoning was based on the force (F) between two electric charges (q_1 and q_2) separated by a distance (r) as given by the equation

$$F = K\frac{q_1q_2}{r^2}$$

where K is a constant (1/K is the permittivity of the separating medium). A similar equation describes the force between two magnetic poles. The constant "K" was assumed to be dimensionless and for convenience of calculations was set to be equal to one, and "unit charges" and "unit magnetic poles" were thus described by these quations, even though a unit magnetic pole was not (and still is not) known to exist.

These unit charges and unit poles were accepted as part of the mechanical dimensions system and were found to have conflicting dimensions dependent on whether the dimensions were derived from the e.s.u. (electrostatic units) or e.m.u. (electromagnetic units) formulae. These dimensions are indicated in Table II, in which may be seen where the centimetre of capacitance was derived.

These dimensions were accepted, and regardless of the resultant confusion are still used in some modern text-books; but since 1960 they have been gradually replaced. As well as relating electric charge to such an obscure "fundamental" quantity as the square root of mass, these systems have confused generations of students by the introduction of such units as the "abampere" of 10 amperes and "abvolt" of 0.01 microvolt, where the same prefix means two different things when related to volts and amperes.

This confusion can be overcome by expressing electric charge (Q) as a fundamental dimension rather than a derivation of mechanical units. When this new dimension is introduced the constant factors which occur in the force equations for electrical and magnetic attraction and repulsion are found to be not dimensionless. In modern terminology these two equations for charges and currents (hence magnetic forces) in free space are expressed as

$$F = \frac{1}{4\pi\varepsilon_0}\,\frac{q_1 q_2}{r^2} \qquad \text{(electrostatic)}$$

and

$$F = \mu_0\frac{I_1 I_2 l}{2\pi r} \qquad \text{(magnetic)}$$

SYSTEME INTERNATIONALE

where ε_0 is the permittivity of free space and μ_0 is the permeability of free space.

James Clark Maxwell investigated dimensions in this form and found that the expression

$$\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

had the dimensions of velocity (LT^{-1}) and predicted that when the correct numbers were put into this expression the velocity would be the velocity of electromagnetic waves in free space. Such a prediction has been proved correct and illustrates the power in the use of dimensional analysis, as the prediction was made in 1865, 23 years before the discovery of such waves by Heinrich Rudolf Hertz.

A further dimension which has to be added to complete the system of fundamental dimensions is an angle, as otherwise torque would have the dimensions of energy, and rotational motion could not be properly expressed.

As far as is known at present, **all** physical phenomena can be expressed in terms of six fundamental dimensions, although temperature and angle are usually neglected and only four fundamental dimensions are used. It does not matter which four dimensions are used, as, for example, mass may be expressed in terms of force (F) and the four dimensions could be F L T Q. Also electric charge may be related to current (I) as $I=Q/T$, so that the four dimensions could be F L T I.

There have been many dimensional systems in use in the past 150 years, but in 1960 it was finally decided by the International Bureau of Weights and Measures that the system to be adopted use the dimensions M L T I, and most standards organisations and teaching institutions in the world now use such dimensions.

Parallel with the development of dimensional analysis, there have been equally confused arguments about the units to be employed in scientific work. The names and sizes of units have been the subject of confusion ever since, and possibly before, the construction of the Tower of Babel.

The "cubit" of biblical times as a measurement of length was rather vague and imprecise, as it was taken as the length of a man's arm from elbow to fingertip and the actual length could vary between about 15 and 20 inches — dependent on who made the measurement. A long measurement of length used in ancient times was the Persian League, which was the distance a man could walk in one hour, and varied not only with the man but also type of country and the estimate of the hour.

Most measurements in the world were as variable as these until King Henry VIII of England decreed an absolute invariable standard of length — the foot— which was the length of his right foot. This was carefully measured, multiplied by three, and the length then inscribed on a brass bar, kept at Greenwich, to be used as the standard reference "yard."

Such a measurement was considered unsuitable for use by French scientists and in 1790 they decided to use a measure based on the size of the earth. This measurement — the metre — was to be one ten millionth of the distance from Equator to North Pole on a meridian passing through Paris. The measurement was carefully inscribed on a platinum-iridium bar which was then deposited for safekeeping in a vault at Sevres. However, the French surveyors measured the distance incorrectly and the metre has only an approximate relationship to the circumference of the earth. Nevertheless it is recognised as a standard of length. The "pound" and "kilogram" were arbitrarily selected as units of mass; international agreement settled the second as a unit of time; and the coulomb as the unit of electric charge.

In Britain, for technical work, there was no doubt of the system of units to be used for measurement. This was the foot-pound-second (FPS) system, but in Europe and for scientific work in Britain, arguments raged over whether to use the centimetre-gram-second (c.g.s.) millimetre-milligram-second (mm,mg,s) or metre-kilogram-second (MKS) system of units. A temporary compromise was made late in the nineteenth century when the c.g.s. system was tentatively adopted by most countries and institutions.

The United States added further to confusion by adopting British names to their own units, such as the U.S. gallon (0.835 Imperial Gallon); and due to a slight difference between the U.S. "yard" and the British "yard" the U.S. mile is about one inch longer than the British Statute Mile.

The c.g.s. system of units was generally used in scientific work for over half a century, but was found to be unsatisfactory in many ways. The abampere, abvolt, statampere and statvolt were not easily related to the "practical" ampere and volt as used in electrical engineering and many units required odd multiplying factors. For example, 1 joule (practical) = 0.238 calorie (c.g.s.)

Because the MKS (metre-kilogram-second) system of units was less confusing and more closely related to practical systems many countries adopted this system for scientific work. In 1960 the International Bureau of Weights and Measures (Comite International des Poids et Mesures) adopted the MKSA (Metre-Kilogram-Second-Ampere) system of units to conform with the dimensions Length, Mass, Time and Electric Current. This is known as the **Systeme International** or S.I. system of units, and has been adopted by most countries in the world. The main exceptions to the adoption of S.I. have been the English-speaking countries. These retain the foot-pound-second for general use, although in May, 1965, the British Government instructed industry to commence conversion to metric systems, and the U.S. measurements are derived from metric measurements. These countries also teach the S.I. in High Schools.

The international adoption of S.I. meant that new definitions of the fundamental units were required, as it is inconvenient that a Standards Association such as the Australian National Standards Laboratory should continue to refer to Paris to determine the length of the metre.

The metre has now been defined in a manner such that it may be reproduced in laboratories with suitable measuring

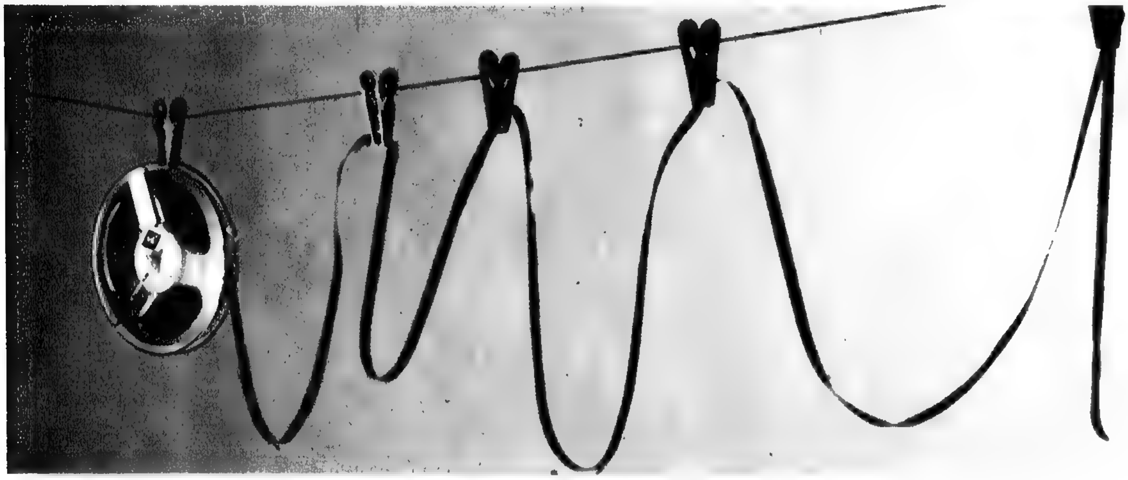
TABLE 1

Dimensions of mechanical Quantities

Quantity	Dimension
Mass	M
Length	L
Time	T
velocity (speed)	LT^{-1}
acceleration	LT^{-2}
Force	MLT^{-2}
Energy (and work)	ML^2T^{-2}
Power	ML^2T^{-3}
Area	L^2
Volume	L^3
Momentum	MLT^{-1}

TABLE 11

Electrostatic Derivation	Dimensional Formula	Electromagnetic Derivation
Electric Charge	$\sqrt{ML^3}\,T^{-1}$	Magnetic Pole Strength
Magnetic Pole Strength	$\sqrt{ML}$	Electric Charge
Electrical Potential	$\sqrt{ML}\,T^{-1}$	Magnetic Potential
Magnetic Potential	$\sqrt{ML^3}\,T^{-2}$	Electric Potential
Capacitance	L	Inductance
Inductance	$L^{-1}T^{-2}$	Capacitance



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apparatus anywhere on Earth — or on other planets — as 1,650,763.73 times the wavelength of the orange light emitted by an atom of krypton-86 when electrically excited as in a gas discharge tube.

The period of one second has been difficult to determine in the past as it was originally defined as 1/86,400th of a day, but the length of each day is different, and in 1956 it was defined as a fraction of a year. The length of the year also changes, so the year 1900 was chosen as a "standard" year and, as this has passed, astronomical observations and calculations can determine its period quite accurately. The period of one second was thus defined as the fractions 1/31,556,925.9747) of the year A.D. 1900. A more reproducible standard, the Caesium Beam Resonator, was selected as a standard in October, 1967. This depends on the resonance of a caesium-133 atom at 9,192.63177-MHz. Clocks operating on this principle are accurate to better than one second in 6,000 years. Descriptions of such resonators were given in "Electronics Australia" in March, 1967 and February, 1968.

No reproducible standard for the kilogram has yet been defined, and mass measurements must still be referred to a block of platinum-iridium alloy known as the "International Prototype Kilogram" kept at Sevres.

The Ampere is defined as the current which will produce a force of 2 x 10^{-7} MKS force units per metre of length of two straight wires separated by a distance of one metre and carrying the same current.

Two other units have been defined. These are the degree of temperature and the Candela (unit of light intensity). When angular measurements are required they are measured in radians where 2π radians = 360°.

The MKSA system has simplified measurements and calculations in many respects but is not a perfect system and the fundamental units could be replaced by more basic standards at some time. The official, and until recently the only legal, definitions of the units are in French (English translations were approved recently: see "Electronics Australia," June, 1969, page 33) but at least these do not have the verbosity of the British Imperial System. The Weights and Measures Act of 1878 gives the following definition of the yard.

"The straight line or distance between the centres of the two gold plugs or pins (as mentioned in the First Schedule to this Act) in the bronze bar by this Act declared to be the imperial standard for determining the imperial standard yard measured when the bar is at a temperature of sixty two degrees of Fahrenheit's thermometer, and when it is supported on bronze rollers placed under it in such a manner as best to avoid flexure of the bar, and to facilitate its free expansion and contractions from variations of temperature, shall be the legal standard measure of length, and shall be called the imperial standard yard, and shall be the only unit or standard measure of extension from which all other measures of extension, whether lineal, superficial or solid, shall be ascertained."

This definition can be compared with the definition of the metre as:

"Le metre est la longuer egale a 1,650,763.73 longuers d'onde, dans la vide, de la radiation correspondent a la transistion entre les niveaux $2p_{10}$ et $5d_5$ de l'atome de Krypton 86."

(Editorial note: The English definition for this is given earlier in the article.)

The units used in the MKSA system are not as confusing to English language people as may be first thought. The metre is approximately one yard in length and as a first approximation for estimating distances this is often good enough. For shorter distances an estimate of 2.5cm for one inch (more exactly 2.54cm equals one inch) will give good results and for precise measurements a rule marked in cm is no harder to read than one marked in inches. For estimating fractions of an inch one-eighth inch is only slightly larger than 3mm.

The kilogram is 2.2lb amd may be first estimated at 2lb. while the metric ton at 2,204.5lb is very close to the British ton of 2240lb.

The unit of force, the newton (the force required to accelerate one kilogram at one metre per second per second), is equal to the downward force caused by a weight of 3.6oz on Earth.

The volt, ampere, ohm and watt are precisely the same units as used in practical electrical work, and there are no awkward conversion factors involved as in the c.g.s. or f.p.s. systems. Similarly one joule is one watt x one second and no conversions such as 0.239 calorie = 1 joule (c.g.s) or 1 BTU = 1055.06 joules = 778.169 ft 1bf (f.p.s.) are required. The joule in the MKSA system is the energy expanded when a force of one newton acts over a distance of one metre.

The MKS volume measurement — the cubic metre — is generally too large for normal use (although one cubic metre of water has a mass of one metric ton) and the litre (1,000 litres = 1 cubic metre) is normally used. The litre is 1.76 pints and to a first approximation there are 4.5 litres to a gallon.

When reading formulae in the MKSA system the simple equations are found to often contain the factor "π." Although this is an awkward number to use accurately, as it is a non-terminating decimal, the inclusion of π does not make the use of the equations harder. For use with simple problems and unrealistic situations, as often encountered during the initial study of a subject, this factor does continuously occur and can be a source of trouble. However, real situations are not "idealised" one-dimensional problems, as charges, magnetic fields and electromagnetic radiation occupy space (and thus volume, usually in spherical form) and the factor π cancels out of the equations in such cases.

As a simple example of this, consider the radian as used in rotational mechanics. If a wheel is turning at 5 radians per second it turns at $5/2\pi$ revolutions per second, as there are 2π radians in one revolution (360°). To determine the linear speed of a point on the circumference of the wheel the number of revolutions per second must be multiplied by the length of the circumference, i.e. by $2\pi r$ where r is the radius in metres. The linear speed is then

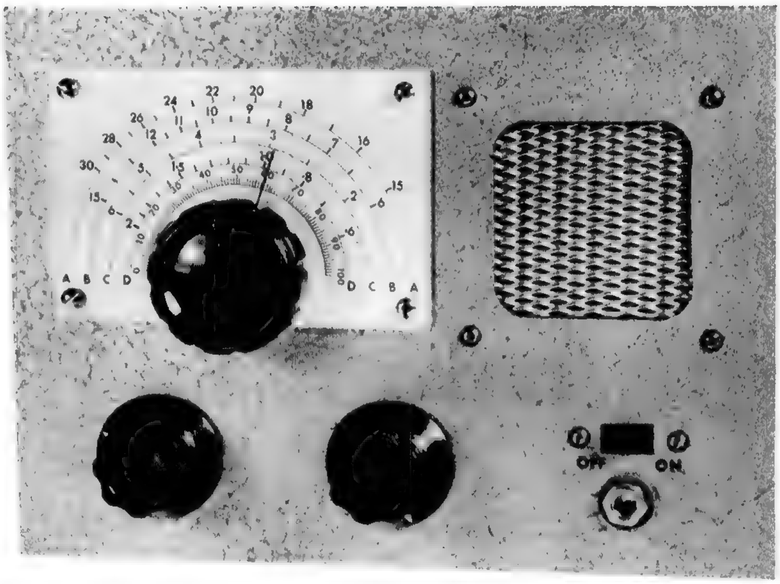
$$\frac{5}{2\pi}\text{ revolutions per second} \times 2\pi r = 5r \text{ metres per second}$$

where the factor "π" has been neatly cancelled. Similar situations occur when considering spatial volumes under the influence of magnetic and electrostatic forces.

It is not possible to leave π out of one situation without it appearing in another and in 1890 Oliver Heaviside wrote of the e.s.u. system "The unnatural suppression of 4π in the formulae of central force, where it has a right to be, drives it into the blood, there to multiply itself and afterwards break out all over the body of electromagnetic theory."

An "All-Wave Two" Receiver for 1970

by IAN POGSON



Although very similar in external appearance to earlier small receivers, our new receiver has an up-to-the-minute circuit using an FET and a microcircuit or "IC". This makes the set an impressive performer, yet also simplifies construction.

Small receivers have always been popular with our younger readers, and indeed, with those not-so-young beginners! The reasons are fairly obvious: The complete set is simple and easy to make, and also tends to be inexpensive. In spite of the simplicity, however, they are generally capable of quite a creditable performance, giving considerable pleasure to the user.

Such receivers in their simplest form only cover the broadcast band. On the other hand, some are made to cover some of the short wave bands only. Perhaps the most popular version is that which combines these two functions, thereby covering the broadcast band and at least a sizeable part of the short wave spectrum.

In years gone by, receivers of this type were all-valve devices, but more recently readers have been looking to solid state versions. Whether valve or solid state, the basic receiver usually consists of a regenerative detector, followed by some sort of audio amplifier.

A typical approach to this classic design, using solid state devices, is the "Fet-Three," described in March, 1968. This covered initially only the broadcast band, but details were subsequently given in the following month, for a set of plug-in coils to extend the tuning range right up to 30MHz.

This little set was the first of our small receiver designs to use a field effect transistor, although we have described other similar receivers in the past, using the more common bipolar transistors. At the time of producing the Fet-Three, the state of the art was such that the FETs available were not all they might be. Junction FETs were the only ones which could be considered, on the score of ease of handling by those inexperienced, and the spread in characteristics of these devices was at the time so wide that it was almost mandatory that each FET had to be adjusted to the individual circuit. In addition, the gain of these FETs was generally much lower than most bipolar transistors.

This situation has since greatly improved, in that junction FETs are now available at quite low cost, with much reduced characteristic spreads and giving greater gain than previously.

The question may well be asked, why all this ado about FETs, when they could be bypassed by the simple expedient of using bipolar transistors anyway. This may be true only up to a point. To be sure, bipolar transistors are quite easy to handle and are capable of high gain. However, there is at least one disadvantage, in that the input impedance in particular is quite low, typically just a few thousand ohms. This means that a tuned circuit could not be shunted directly by the base-emitter junction of the transistor, as the resultant loading would reduce the Q of the circuit to an unusable level. This may admittedly be overcome to a large degree by tapping the base well down the coil.

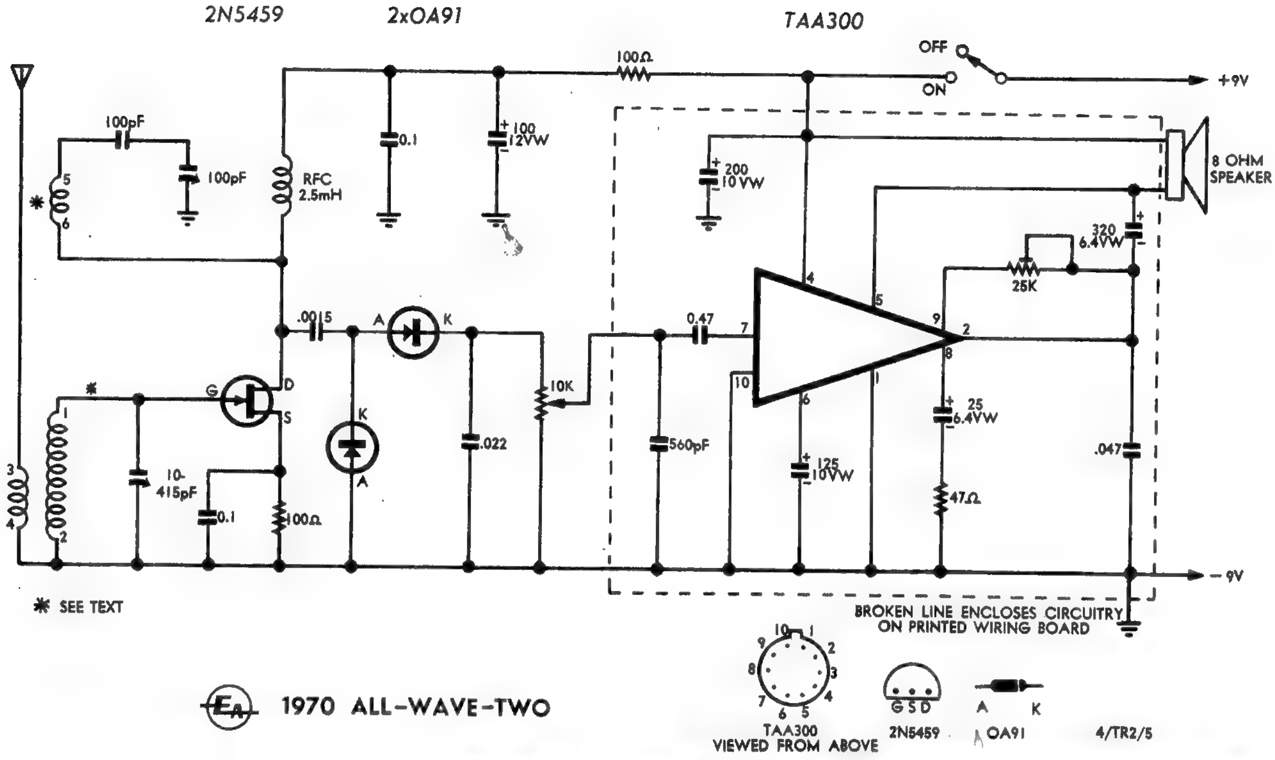
On the other hand, FETs have a very high input impedance between the gate and source, comparing favourably with the high input impedance between grid and cathode of a valve. With either of these devices, the coil may be connected directly across the input elements, with loading being virtually insignificant. Considering this advantage of the FET, together with the more simple bias requirements, then we have at least a reasonable case for using it. In addition, FETs can provide somewhat less obvious but equally important advantages in terms of improved overload and cross-modulation performance, although these advantages may not be of great significance in the case of the small receiver.

A modern design for a small receiver may use a FET to advantage in the "front end," then. But what about the audio section? To return to the Fet-Three for just a moment, this used a straightforward two-stage audio amplifier, capable of sufficient output to drive a loudspeaker. This would still make a very satisfactory arrangement. However, with progress in the solid state field, microcircuit or "IC" audio amplifiers are now available. The Philips device type TAA300 is a typical example, an audio amplifier made up around this device giving approximately 1 watt of audio, with an input sensitivity of 8mV or less, and with a modest supply of nine volts.

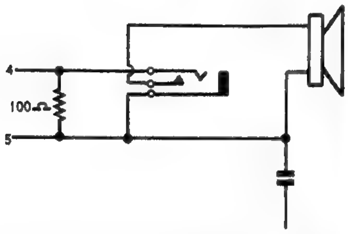
Armed with the new advantages of the latest FETs, together with the new audio ICs, we recently set ourselves the task of improving the Fet-Three. The goals which were voluntarily set included such things as the use of one FET and one IC, the idea being simplicity together with optimum use of these devices. Also, if at all possible, the receiver should cover from the broadcast band, right up to 30MHz. Battery operation would be the prime mode but operation from a mains power supply could be an alternative. To keep construction simple, plug-in coils would be used, rather than a switching system.

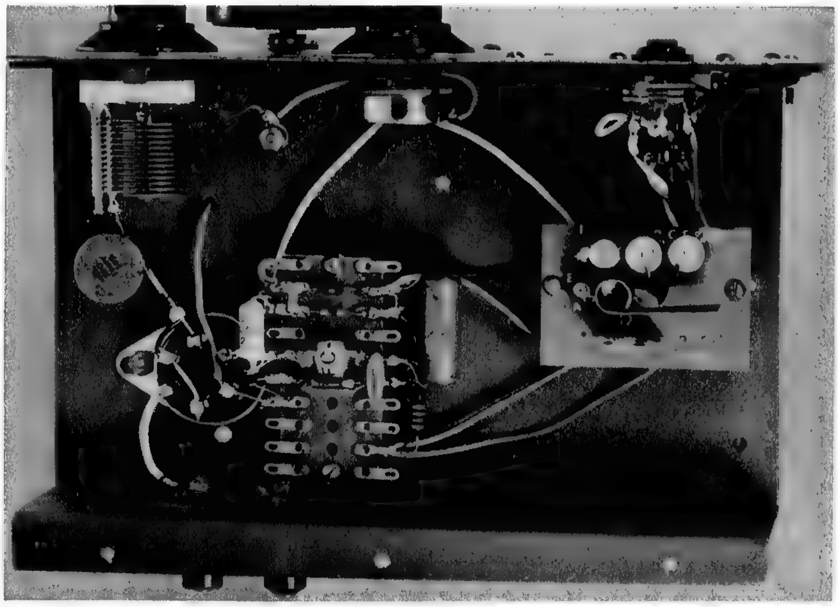
In considering all these points, the One Transistor Reflex receiver of June 1963 also came to mind, as this receiver was a very high performer. Basically, it consisted of a regenerative RF amplifier, followed by a voltage-doubler detector. The audio from the detector was then fed back into the transistor, which functioned this time as an audio amplifier. (This is called "reflexing").

It would be possible to use the reflex approach in a new design, and a rege-



1970 ALL-WAVE-TWO





At the top of the page is the circuit diagram, with the extra circuitry for headphones, immediately above. At right is an underchassis picture showing the location of components. Note the heat sink on the IC.

nerative RF amplifier too, but using an FET, instead of the transistor as formerly. The voltage-doubling detector could also be used as this gives virtually double the audio output voltage, for the modest outlay of an extra germanium diode. However, the reflexing would pose considerable problems on the short-wave bands, and in any case can sometimes involve the beginner (and the more experienced constructor!) in obscure instability problems.

We have therefore decided to reject the reflexing idea, while adopting the idea of combining the regenerative FET amplifier with a voltage-doubling diode detector. And so we have the basis for our new design already. It is just a matter of explaining the details.

Let us have a look at the circuit and see just how it has all worked out. As mentioned before, the first stage is a regenerative RF amplifier. Each plug-in coil consists of three windings, a primary, a tuned secondary, and a feedback, "tickler" or reaction winding. The aerial is connected to the primary winding and the secondary is tuned to the wanted signal with a variable capacitor of 400pF or so maximum capacity. Feedback via the third winding is controlled by the variable reaction capacitor of about 100pF.

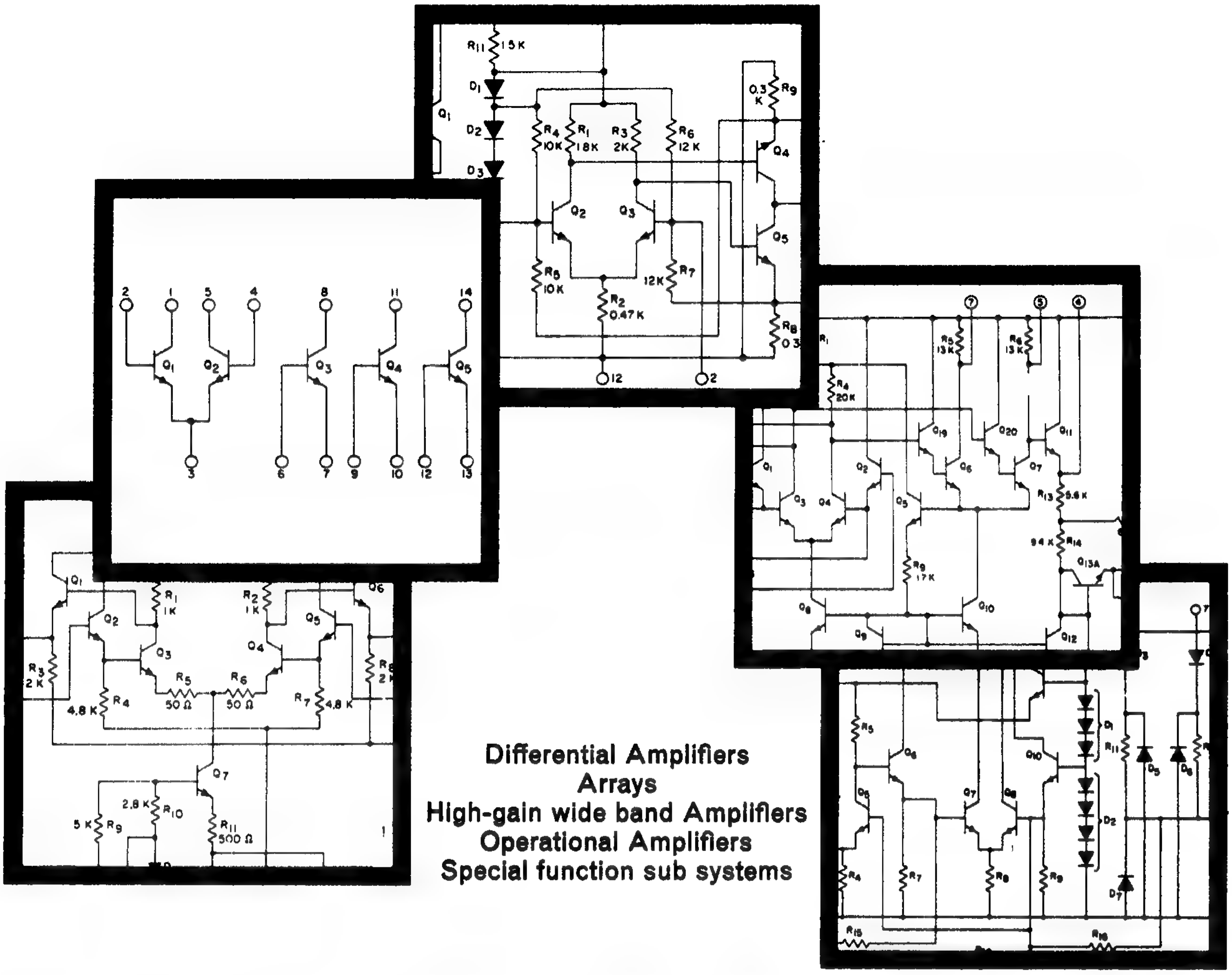
It may be noticed that there is a self-bias resistor of 100 ohms in the source circuit of the FET. This is a design centre value for this type of FET and should not be varied. The resistor is shown bypassed to RF as would normally be expected. It may be worthwhile to experiment here, however, by omitting the 0.1uF bypass, as the resulting degenerative effect opposes the regeneration and can sometimes make regeneration smoother. We found it better in our case to leave the bypass in circuit.

Due to the relatively high current taken by the FET and the modest supply voltage, it is necessary for correct operation to have a drain load which is high to the RF signal, yet which does not cause an excessive DC voltage drop. This is achieved by using a 2.5mH RF choke in this position.

Following the RF stage is a half-wave voltage doubling detector comprising the .0015uF and .022uF capacitors and the two germanium diodes. The detector circuit is identical with that of the half-wave voltage doubler rectifier used in power supplies, the only difference being in terms of component values. Where one has to deal with low frequencies as in a power supply, the capacitors are generally high value electrolytics, and the diodes are of the power type.

Instead of being connected to the secondary of a power transformer, the detector obtains its signal from the output of the RF amplifier. At the output end of the detector, the equivalent load is the 10K volume control.

The audio amplifier which follows is built around the TAA300 IC previously mentioned. Assembly is on a printed wiring board, and all the components shown within the dotted lines are ac-



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commodated on the board. This includes an extra component, a 560pF capacitor, which is suggested by Philips to restrict the high frequency response and thereby avoid any possibility of high frequency instability.

The audio amplifier is designed to feed into a loudspeaker of 8 ohms. This is the minimum impedance which should be used, but the impedance may be increased if desired to 15 ohms, with a small reduction in audio output.

Perhaps the last item of main interest on the circuit is the decoupling introduced in the supply line from the 9 volt source, to the RF amplifier. The decoupling consists of a 100 ohm resistor, a 100uF capacitor and a 0.1uF capacitor, the latter capacitor normally being required to ensure a low impedance RF path across the power source. However, to eliminate a small amount of instability due to interaction between the RF amplifier and the audio amplifier, we found it necessary to introduce the additional 100 ohm resistor and 100uF electrolytic.

For those readers who wish to use a pair of headphones either additionally or instead of a loudspeaker, we have made provision for this. The circuit modification involved is shown separately, and the jack involved is fitted to the front panel, just below the slider battery on/off switch. It will be noted that there is a 100 ohm resistor shunted across the speaker circuit and wired directly to the jack. This is to provide for the minimum load to be presented to the audio IC output, in the event of an otherwise open circuit or more likely, for when a pair of high impedance headphones are used.

While on the subject of headphones, it might be worthwhile to note that these fall into two broad categories, high and low impedance. The type which was common years ago and more particularly those used on crystal sets, were of high impedance, usually between 2,000 and 4,000 ohms. On the other hand, low impedance types are nowadays quite common and these are generally around 8-40 ohms. Either type would be suitable for use on this receiver.

The prototype set was built up on the very same chassis and panel which was used for the original Fet-Three. Indeed, if our memory is not playing tricks, this chassis and panel have also been used for even earlier projects! The chassis measures 8in long by 4¾in wide, by 1¼in deep, with a ½in lip along the rear edge. The panel size is 9in by 6 5-8in and this size corresponds with one of our standard instrument boxes. It is of course up to the builder to decide whether or not he fits the finished set into a box.

As an alternative to the chassis just described, the set may be built up breadboard style using a piece of board to mount the components which would otherwise be fixed to the chassis. However, an earthed metal front panel is a "must" in order to minimise hand capacitance effects when tuning.

The dial assembly is a Jabel kit which uses a smooth planetary vernier arrangement. It is distributed by Messrs Watkin Wynne and should normally be available through your local supplier. The dial is mounted directly to the front panel, along with the 3in loudspeaker. Whilst on the subject of speakers, it is worth noting that although such a small speaker gives a satisfactory account of itself, the larger types are generally more efficient and one of these could be used to advantage if desired. This would probably dictate the use of a larger case unless the speaker were housed separately.

The front panel is fixed to the chassis simply by mounting the volume control, reaction capacitor, on/off switch and headphone jack. When mounting these components, it is important to remember to insulate the headphone jack from the chassis and panel.

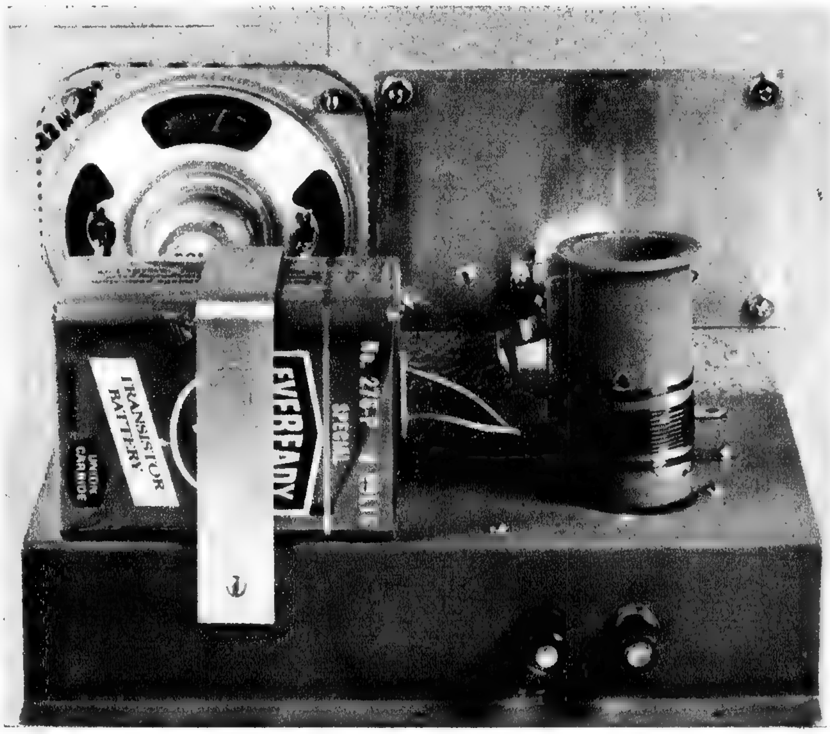
The headphone jack is normally insulated with a pair of fibre washers. If no means are provided for stopping the bush from touching the metalwork inside the hole, then care must be taken to see that the hole is oversize and that the bush is centred so as not to allow a short circuit.

The reaction capacitor which we used is also a component distributed by Watkin Wynne, and it is mounted by two small screws threading into metal blocks in the end insulating material. This method insulates the capacitor from the panel and so a lead must be run from the rotor plates to an earth lug nearby. If you use a capacitor with the familiar rotor bush mounting, then it will be automatically returned to earth.

A further word about the reaction capacitor. We used one with a maximum capacitance of 100pF and to make adjustment somewhat easier, we connected a 100pF NPO ceramic capacitor in series with it. If a variable capacitor of 50pF is available, then it may be used and there will be no need for the 100pF series capacitor.

The main tuning capacitor in the prototype is one made by Roblan, and also distributed by Watkin Wynne. It has a maximum capacitance of 415pF. This is not really essential and if you have an old one in good condition which approximates the size required, electrically and physically, then it would be in order to use it. This capacitor is mounted on the top of the chassis and immediately behind the dial mechanism.

Immediately behind the tuning capacitor, is a six-pin valve socket, for the set of plug-in coils. The coils are all wound on moulded formers, 1¼in diameter and with a six pin base. More will be said about winding the coils later on.



This rear view of the chassis shows the location of the major components and the bracket used to hold the battery in place. The tuning capacitor is immediately behind the plug-in coil.

We used a nine volt type 276-P battery for the prototype and this is held to the chassis with an "L" shaped aluminium bracket. The aerial and earth terminals are fixed to the back skirt of the chassis. The earth terminal should make good electrical contact to the chassis, whereas the aerial terminal must be insulated with the washer provided.

The FET RF amplifier and detector are wired up on a piece of tag board, in our case, a piece with 10 pairs of tags. This is not really necessary and a shorter board may be used, provided it has enough tags for the job. Details of this board are given in the wiring diagram. It is also important to note that this board is mounted adjacent to the six pin coil socket, so that leads may be kept as short as possible.

The IC audio amplifier is built on a printed board, in our case type No. 745, made by RCS Radio. More than likely, boards may be made available by other manufacturers as well. The assembled board is mounted in a convenient position underneath the chassis. The position is not vital, so long as it fits in conveniently with other components. At the same time, if you consider moving it from the indicated position, it would be wise to keep the input end as far as possible from the active detector circuitry. It should also be

noted from the picture that there is a heat sink clip on the IC.

The overall construction and assembly order is not really vital, but perhaps a good place to start would be with the audio amplifier board. There are only ten items to be soldered in place and the board is complete. The diagram should be followed carefully and a few important points should be observed to ensure success. Make sure that all the electrolytic capacitors are in their correct positions and that the correct polarity is observed. When fixing the IC, make sure that it is done with due respect for the correct orientation of the connections. The tag on the IC is between connections 1 and 10 and these should be soldered to the appropriate band of copper on the board. The other connections will automatically be correct.

Before leaving the audio board, there is one extra component which has to be added, making the tenth, and this is the 560pF capacitor across the input. It is wired underneath the board, from pin 7 of the IC to a convenient point on the earthed part of the copper.

Although this completes the wiring of the board, it is still necessary to provide the heat sink clip for the IC. We made one up from a piece of copper sheet, about 24 gauge and measuring 2in x ¾in. One end was wound around a 5/16in diameter drill and the resulting loop was adjusted by hand, to the correct diameter, such that it was a neat fit over the case of the IC. Although copper is excellent for this job, other metals such as brass, aluminium, or steel, would probably be satisfactory.

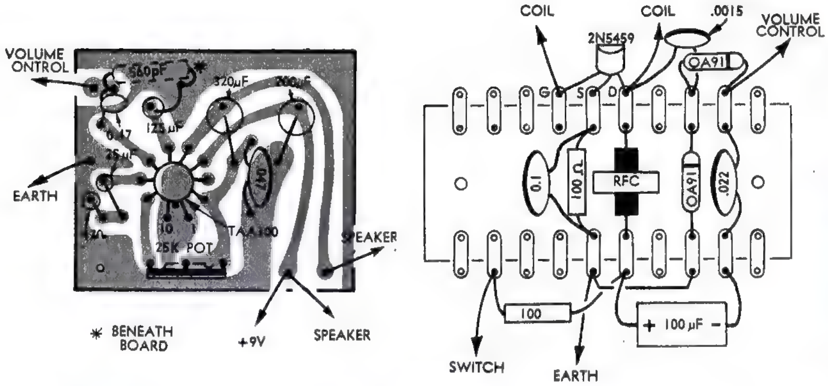
The next job could be to wire up the tag board which supports the RF amplifier and detector components. This is straightforward and no trouble should be experienced in following the diagram. It may be well at this point to mention that when making all the soldered joints on this and elsewhere, that care should be taken to ensure a good joint but at the same time, avoid overheating of the components.

The bracket to hold the battery in place can be fashioned from a strip of 16-gauge aluminium, about 6½in long and ¾in wide. This is formed into an "L" shape, or rather that of a "U," with one long leg and one only about ¾in long, and can be fashioned by actually bending it around the battery to be held. The general idea can be obtained from the picture. A hole is required near the end of the long leg, with a matching hole on the back skirt of the chassis.

There are four plug-in coils and these may now be wound. The coils are wound on 1¼in diameter moulded formers which include a standard six-pin base. The formers which we used are made by RCS radio and may be obtained direct, or from your local supplier.

It may be noted that there are two thick pins on these formers, the pins being numbered clockwise from one to six with the two thick pins being "one" and "six." All of the winding details are given in the table and this is backed up with two diagrams, showing just how the windings are placed on each former.

For the sake of convenience, only three popular enamelled wire gauges (SWG) have been specified. Wires of slightly different thickness and/or different insulation could be used but allowance should be made for the different space occupied by the wind-



At left is the audio board shown from the component side, with the copper shown as it would appear when held up to the light. The RF amplifier and detector tag board is at right.

ings and the resulting effect on the inductance.

The arrangement of the windings on the former is shown in the accompanying diagrams, one applying to three of the coils while the other, with interwound primary and secondary windings, applies to the coil for the highest frequency band. All coils are wound in the same direction.

Exact coil requirements for any individual set are affected by the components and the reception conditions generally, so that a little experimenting will often result in greatly improved performance.

A typical example is the reaction winding. If the receiver fails to oscillate toward the low frequency end of the band, it may be necessary to increase the number of turns on the reaction winding and/or move it closer to the secondary winding. If the reaction cannot be readily controlled then less reaction is probably in order, and the above procedure should be reversed.

We have shown pin numberings on the circuit, for the coil terminations. These are suggested and are what we actually used, as they make for reason ably short leads which need to be run to other points. If you alter these connections, then it should be done with short leads in mind.

The dial knob spindle may be just a little too long and this point should be checked. If necessary, cut off no more than is necessary with a hacksaw. A convenient way to do this, is to hold the spindle in a vyce, which steadies the assembly while the unwanted end is cut off.

Having done all this preparatory work, the reader should now be in a position to take on the final assembly. As mentioned previously, the front panel is fixed to the chassis by means of the front controls and this may therefore be the first operation, to bring the chassis, panel and front controls together. The loudspeaker and dial may be next. The tuning capacitor, which has its spindle fixed to the dial drive, is mounted next. Before doing so, make sure that you have soldered a lead to the lug to the fixed plates. The lead should be long enough to reach the coil socket.

Mount the coil socket and the aerial and earth terminals. Then follows the RF amplifier and detector board. This is stood off from the chassis with a pair of ¼in spacers, ¼in diameter and tapped to 1-8in Whitworth. Before similarly mounting the audio board, it would be advisable to solder leads to the appropriate points, which run to other parts of the receiver. This only leaves the battery to be fixed, with the clamp all ready made for it.

We are now in a position to do all the wiring between units and other individual components, such as the switch, phone jack, loudspeaker, volume control, coil socket, etc. When carrying out this part of the job, +9V supply

PARTS LIST

1 Chassis and panel to suit
1 Dial scale and drive assembly
1 Speaker to suit, 8-15 ohms VC
1 9-volt battery, Eveready 276-P, or similar
1 Switch, on/off
1 Plug to suit battery
1 Phone jack, insulated mounting, with normally open contacts
1 6-pin valve socket
4 6-pin coil formers, 1¼in dia.
2 Terminals, aerial and earth
1 Printed wiring board, RCS 745 or similar
1 Tag board, length to suit
1 2N5459 or MPF105 junction FET
1 TAA300 audio microcircuit
2 OA91 or similar germanium diodes.
2 Brass spacers, ¼in long, ¼in dia., tapped 1/8 in Whit.
1 2.5mH RF choke

RESISTORS

1 47 ohms, ¼w
2 100 ohms, ¼w
1 10K (log.) potentiometer
1 25K preset potentiometer

CAPACITORS

1 100pF NPO ceramic
1 100pF miniature variable (see text)
1 415pF single gang variable
1 560pF low voltage polystyrene
1 .0015uF low voltage polyester
1 .022uF low voltage ceramic
1 .047uF low voltage ceramic
2 0.1uF low voltage ceramic
1 0.47uF low voltage ceramic
1 25uF 6.4VW electrolytic
1 100uF 12VW electrolytic
1 125uF 10VW electrolytic
1 200uF 10VW electrolytic
1 320uF 6.4VW electrolytic

MISCELLANEOUS

Hookup wire, solder, lugs, screws, nuts, expanded aluminium for speaker, heat sink for IC, knobs, etc.

should only be run to the audio amplifier, omitting the run to the RF amplifier.

At this point, we are just about ready to carry out the first test and adjustment. But before doing so, make a thorough check of the assembly and wiring, to make sure that there are no errors or omissions. When satisfied about this and if one is available, connect a multimeter in series with +9V supply lead to the audio amplifier. Set the multimeter to the 100mA, or a higher range and switch on. Adjust the 25K potentiometer on the audio board, for a quiescent current of 8mA. If a meter is not available, then we suggest that you set the potentiometer to mid range.

With the battery switch off, disconnect the meter from the circuit and restore the lead to the battery plug. Leave the plug disconnected from the battery. Run the lead which was omitted earlier, from the 9V supply to the RF amplifier. The set is now ready for final testing and any calibrations which may be considered necessary or desirable. We are making available a photographic copy of the original scale, through the Information Service, for 50c each. The calibrations should be a good approximation for this type of set and no further calibration process will be necessary. The alternative is to carry out your own calibration.

In any case, the next thing is to check that the receiver is functioning normally. This can be done by plugging in preferably the lowest frequency coil and connecting the aerial. More will be said about aerials later on. Having established that all is well, those who do not have to do any calibrating may skip over the next few paragraphs and read what then follows.

For readers who wish to calibrate their own dial scales, we will first assume that you have a signal generator or calibrated oscillator at your disposal. This is an operation which can be both easy and interesting, and we suggest that you proceed as follows:

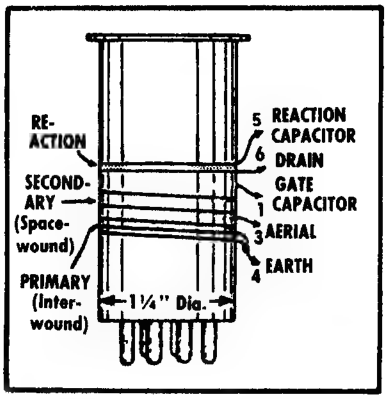
Unscrew the four screws holding the perspex plate which covers the dial scale, remove the perspex and replace the screws. Plug in the coil for the broadcast band and connect the signal generator to the aerial and earth terminals.

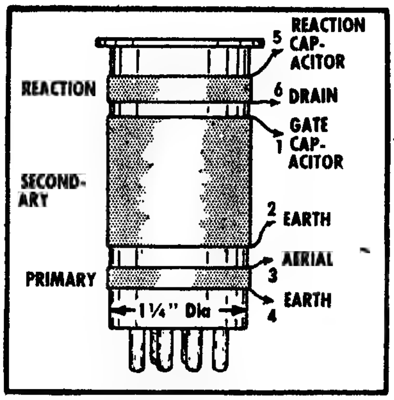
Set the signal generator to say, 600KHz and set the output level no higher than is necessary for an easily detected signal. Adjust the regeneration almost to the point of oscillation and find the signal on the receiver. Mark this position in pencil on the appropriate scale on the dial. Repeat this process at frequencies differing by 100KHz steps, right across the dial to 2MHz.

Plug in the 2 to 6MHz coil, and calibrate this range with points at say 500KHz intervals. Next, plug in the 6 to 15MHz coil and calibrate the appropriate range in a similar manner. Finally, with the 15 to 30MHz coil in position, calibrate at intervals of say 1MHz.

Now remove the dial scale and carefully mark each point with a lining pen and black drawing ink. Figures corresponding to the calibrations are filled in and the scales then refitted to the dial. The reproduction of our scale will serve as a guide to the finished scales.

If you do not have access to a signal generator, then the dial scale just mentioned will give a good idea where to expect the various calibrations to fall. Unfortunately, it is hardly likely that





BAND	AERIAL PRIMARY	SECONDARY	REACTION
550KHz to 2MHz	15T. of 32SWG. Spaced 3/16in from earth end of secondary.	100T of 32SWG. Close wound.	40T. 40SWG. Spaced 1/8in from gate end of secondary.
2MHz to 6MHz	11T. 32SWG. Spaced 1/8in from earth end of secondary.	27T. 25SWG. Close wound.	13T. 32SWG. Spaced 1/8in from gate end of secondary.
6MHz to 15MHz	5T. 32SWG. Spaced 1/16in from earth end of secondary.	10½T. 25SWG. Spaced to occupy ½in.	5T. 32SWG. Spaced 1/8in from gate end of secondary.
15MHz to 30MHz	1T. 32SWG. Interwound from earth end of secondary.	4½T. 25SWG. Spaced to occupy ½in.	3T. 32SWG. Spaced 1/8in from gate end of secondary.

At top left are details for the high band coils, showing interwinding for top coil. At right, details for the close wound lower band coils. Immediately above are complete coil winding details.

the coils which you make will match exactly the coils which we have made and so the calibrations are not likely to be accurate for your receiver. Guided by our scale, however, you should be able to log stations progressively at known frequencies and so build up the calibrations in that way.

Finally, here are some pointers which should be a useful guide to the tuning and operation of this kind of receiver.

When the reaction or "regeneration" in the RF amplifier is increased, the sensitivity is also increased and selectivity is sharpened as well. Sensitivity and selectivity reach a maximum just at the point of oscillation. For the reception of AM signals, the regeneration should normally be set just below the point of oscillation. However, when attempting to receive very weak signals which are not satisfactory under these conditions, it is often possible to copy them if the RF amplifier is made to oscillate and the signal carefully tuned so that there is no whistle.

For the reception of morse code or "CW" signals, the RF amplifier is brought to the point of oscillation and then the signal is tuned slightly to one side or the other, thus producing a whistle or beat note. The note is selected to suit the convenience of the listener. The side selected does not matter but if interference is present, it can often be avoided by selecting a particular side.

Again, for SSB reception, the RF amplifier is made to oscillate and the signal is resolved by carefully tuning for the best speech quality. Note that when the RF amplifier is made to oscillate for all the conditions just mentioned, there is no point in advancing the regeneration control beyond the position where reliable oscillation is achieved.

Another important point concerns adjustments for volume with strong AM signals. Do not back off the regeneration control if the volume is too high. This practice will certainly reduce the volume, but the selectivity will be seriously degraded as well. The correct procedure is to leave the regeneration at maximum and use the volume control. For CW and SSB reception, the question does not arise, since the volume level can be adjusted only with the volume control.

Suitable aerials could be quite a topic in itself. For best results over the full coverage of the receiver, a number of different types of aerials would be desirable. The needs will very according to the location and the frequencies on which most interest rests.

As a guide, for broadcast band and frequencies up to about 3MHz, a random length of wire would be suitable. This may be inside or outside and of such a length as suits local conditions, proximity of wanted stations, etc. For general short wave reception, the Twin Doublet Aerial as described in the issue for November, 1963 would be very suitable. If on the other hand the amateur bands are of prime interest, then an aerial designed specially for these bands would be the logical choice.

The IC audio amplifier operates under class "B" conditions and briefly, this means that the louder the volume, the higher will be the current drawn from the battery. Therefore, only use sufficient volume for the prevailing conditions.

SILICON CONTROLLED RECTIFIERS.

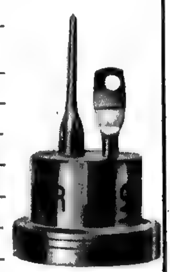
Item	Symbol	2SF 101	2SF 102	2SF 104	2SF 106	2SF 108	2SF 656	2SF 657	2S 658	Unit
*Non Rep. P.R.V.	$V_{R\ surge}$	75	150	300	400	500	75	150	300	V
*Rep. P.R.V.	V_{RM}	50	100	200	300	400	50	100	200	V
*Rep. PK. Fwd. Blocking Voltage	V_{FOM}	50	100	200	300	400	50	100	200	V
Avg. Rect. Current	I_O	200(T_a=50°C)					300(T_a=25°C)			mA
		470 r.m.s.								

SILICON CONTROL RECTIFIERS.

Item	Symbol	2SF 660	2SF 661	2SF 662	2SF 664	Unit
Non Rep. P.F.V.	$V_{F\ surge}$	75	150	300	600	V
Non Rep. P.R.V.	$V_{R\ surge}$	75	150	300	600	V
Rep. Pk-Fwd. Blocking Voltage	V_{FOM}	50	100	200	400	V
Repetitive P.R.V.	V_{RM}	50	100	200	400	V
Avg. Rectified Current	I_O		3.5(Ta=50°C)FN11 H.Sink			A
		6.3(Tc=50°C)		10Ar.m.s.		
PK 1 cycle surge	I_{surge}		50			A

BIDIRECTIONAL THYRISTER.

ITEM	Symbol	AC06BR	AC06DR	AC10BR	AC10DR	UNIT	REMARKS
Peak Block Voltage	V_{BLM}	200	400	200	400	V	
Conduction RMS Current	I_{RMS}	6		10		A	Tc=75°C or Ta=40°C With FN12 H.Sink
Surge Current	I_{surge}	50		80		A	1 Phase, 1 Cycle
Peak Gate Current	V_{GM}	±10				V	
Peak Gate Current	I_{GM}	±3.0				A	
Peak Gate Power	P_{GM}	5.0				W	
Avg. Gate Power	P_{GAV}	0.5				W	
Junct. Temp.	T_j	100				°C	
Storage Temp.	T_{stg}	−25~+100				°C	
Stud Torque	—	30		35		kg cm	



PLANAR TYPE UNIJUNCTION TRANSISTOR.

ITEM	Symbol 2SH16 2SH17	Condition	
Power Dissipation	P	200	mW
Emitter Rev. Voltage	V_{B2E}	30	V
Interbase Voltage	V_{BB}	25	V
Peak Emitter Current	I_{EM}	1	A
Emitter Current	I_E	50	mA
Junction Temp.	T_j	—20~+125	°C
Storage Temp.	T_{stg}	—20~+125	°C

TRIGGERING DIAC.

ITEM	Symbol V413	Specification MIN.	Typ.	MAX.	UNIT
Breakover Voltage	$V_{BO1}(V_{BO2})$	26	—	40	V
B/Over Voltage Symmetry	$\Delta V_{BO}(\lvert V_{BO1}-V_{BO2}\rvert)$	—	—	3.5	V
B/Over Current Symmetry	$I_{BO1}(I_{BO2})$	—	—	200	μA
B/Over Voltage T/C		—	0.1	—	%/°C
Peak Output Voltage	V_P	4.5	—	—	V

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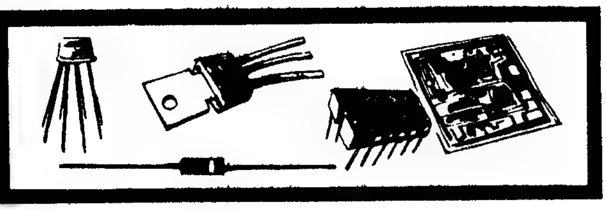

Chapter 11

by Jamieson Rowe

Characteristics and ratings — collector-emitter breakdown voltage ratings — sustaining voltage ratings — punch-through — second breakdown —maximum collector junction temperature — thermal resistances and maximum power dissipation — packages and heat sinks — current ratings — emitter junction resistance and input resistance — current gain and current level — transconductance — frequency response — gain-bandwidth product.

Some of the behaviour characteristics and ratings of the basic bipolar transistor were introduced in the latter portion of the preceding chapter. The present chapter will build upon this material by examining further aspects of behaviour which relate to practical bipolar devices.

It may be recalled that avalanche breakdown was the reason given for the limitation of collector-emitter voltage applied to a bipolar transistor connected in the common emitter configuration. While in general and with modern devices this explanation is largely true, it is in fact a very simplified one which should now be expanded and qualified if the reader is to gain a satisfying insight into actual device behaviour.

As explained earlier, the collector-emitter breakdown voltage tends to somewhat lower than the collector-base breakdown voltage BVcbo, because in the common emitter configuration the device is capable of amplifying its own collector-base reverse bias current or "leakage" current. The amplification action provides more carriers to take part in avalanche multiplication, so that the two effects are cumulative. Yet the degree to which the device does in fact amplify its leakage current will naturally depend upon the effective bias conditions at the base-emitter junction, as the amplification action of the device involves both junctions.

The voltage at which collector-emitter avalanche breakdown occurs thus depends not only upon the internal geometry and doping levels of the device itself, but also upon the external bias and circuitry connected between emitter and base. In other words there is really no fixed and distinct "collector-emitter breakdown voltage" for a particular device, but rather a whole range of breakdown voltages corresponding to different emitter-base bias conditions.

Generally the lower limit of this range corresponds to the situation where the base of the device is effectively "floating," or open circuit. In this situation the device is able to amplify virtually all of its leakage current, as almost all carriers which reach the base region from the collector are effective in attracting carriers from the emitter. Avalanche breakdown thus occurs at a relatively low voltage.

It is actually this "base open" value of collector-emitter breakdown voltage which is given the symbol **BVceo** introduced in the last chapter. As the lowest value of collector-emitter breakdown voltage displayed by a bipolar device, BVceo is often of considerable importance for circuit design.

The upper limit of the breakdown voltage range generally corresponds to the situation where the base is reverse-biased with respect to the emitter. Here virtually no leakage current amplification can take place. The reverse bias on the base-emitter junction discourages carrier injection, while carriers reaching the base region from the collector are virtually "sucked" out of the base by the bias on the base electrode. Avalanche breakdown thus tends to occur at a relatively high voltage, approaching the collector-base breakdown voltage BVcbo.

The symbol usually employed to represent the "reverse biased" collector-emitter breakdown voltage is **BVcev.** In some cases manufacturers test devices for reversed-bias collector-emitter breakdown with a specified resistor in series with the reverse base bias, and in these cases the breakdown voltage may be symbolised **BVcex.**

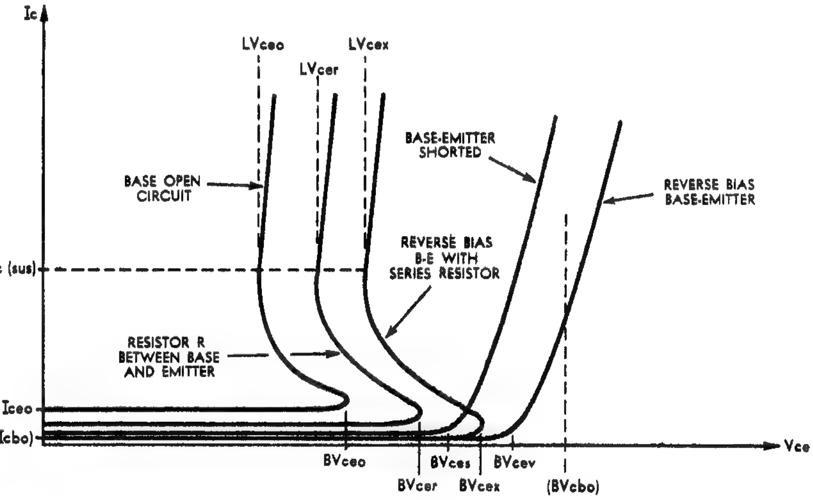

Figure 11.1 NOTE: LEAKAGE CURRENT LEVELS EXAGGERATED FOR CLARITY

Almost as high as the breakdown voltage for reverse base-emitter bias is that which corresponds to the situation where the base is effectively short-circuited to the emitter. Here the device is capable of only very slight amplification of its leakage current, as the base-emitter junction is virtually clamped in its equilibrium state.

A further symbol is used to represent this "base shorted" breakdown voltage, as one might expect. The symbol is **BVces.**

If external resistance is introduced between base and emitter, a higher proportion of carriers reaching the base region from the collector are able to attract carries from the emitter, and the device begins to amplify its leakage current. The breakdown voltage thus falls from the "base shorted" value BVces, and as the circuit resistance is increased it falls ultimately to the value BVceo.

To provide the circuit designer with a measure of the rate at which the collector-emitter breakdown voltage of a device falls with increasing base circuit resistance, some device manufacturers quote a value of breakdown voltage which corresponds to a particular value of external base-emitter resistance. This is given yet another symbol: **BVcer.**

Depending upon base-emitter bias and circuit conditions, then, the collector-emitter breakdown voltage of a bipolar transistor can vary significantly over a range having a lower limit of BVceo and an upper limit of BVcev. This is illustrated in figure 11.1, where the breakdown characteristics of a typical modern silicon transistor are shown for each of the situations described in the foregoing. The value of collector-base voltage corresponding to BVcbo is

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shown as a dashed vertical line, for comparison.

From the shape of the BVceo, BVcer and BVcex curves, it may be seen that whenever the base circuit contains effective external resistance, the device breakdown characteristic enters a negative resistance region immediately following breakdown. Basically this occurs because although the device amplification action contributes to the onset of avalanche breakdown by means of the external base circuit resistance, it effectively ceases as soon as avalanching begins.

Because of this negative resistance behaviour, measurement of breakdown voltages BVceo, BVcer and BVcex can pose considerable problems. The negative resistance of the device tends to interact with device lead inductance and capacitances associated with the semiconductor chip and its package, generating oscillations which upset the measurement.

For this reason some device manufacturers tend to measure and quote not the actual breakdown voltages for these situations, but collector voltage values which correspond to the region where the breakdown characteristic has in each case passed through the negative resistance region and entered a second positive resistance region. These voltage values are known as **sustaining voltage ratings**, and as may be seen they are symbolised respectively as **LVceo, LVcer and LVcex.**

Note that when sustaining voltages are quoted for a device the corresponding collector current level must be specified. This is shown on figure 11.1 as Ic(sus). It may be seen that the sustaining voltage value in each type of situation is somewhat lower than the actual breakdown voltage, so that sustaining voltage ratings for a device may generally be regarded as quite conservative.

From the foregoing it may be appreciated that the collector-emitter avalanche breakdown behaviour of a bipolar transistor is somewhat more complex than that of the collector-base junction, its description involving the use of no less than eight different voltage measures of breakdown behaviour.

Unfortunately, perhaps, even this is not the full story, for in fact avalanche breakdown is only one of a number of mechanisms which can result in collector-emitter breakdown. Another mechanism is commonly called **punch-through** or "reach-through."

Punch-through occurs if the collector-emitter voltage applied to a device is increased to the point where the depletion layer of the reverse biased base-collector junction extends right through the narrow base region and reaches the emitter junction. Naturally when this occurs the current passed by the device rises rapidly, as the potential barrier of the emitter-base junction is destroyed, and the base effectively becomes nothing more than an accelerating field region linking the similar-material emitter and collector regions.

Like avalanche breakdown, punch-through is not inherently a destructive mechanism; it is merely a mechanism whereby the resistance of the device drops abruptly at a certain value of applied voltage. However, as with avalanche breakdown, it is a potentially high-dissipation mode of device operation, so that device damage can occur if the power dissipated by the device is not limited by the external circuit. The symbol usually employed to represent the punch-through voltage of a device is **Vpt.**

If avalanche breakdown occurs in a device at a voltage lower than that necessary for the collector junction depletion layer to extend fully through the base region, punch-through does not occur. The reason for this is that the collector junction depletion layer ceases extending when avalanche occurs. Hence in general terms a device breaks down due to either avalanche breakdown or punch-through, but not both.

Which of the two mechanisms is responsible for breakdown in any particular situation depends partly upon the internal geometry and doping levels of the device concerned, as these factors basically determine the voltage levels necessary to initiate each mechanism. For this reason some types of modern silicon device employing carefully controlled geometry and doping levels almost always enter avalance breakdown first, and punch-through is extremely rare.

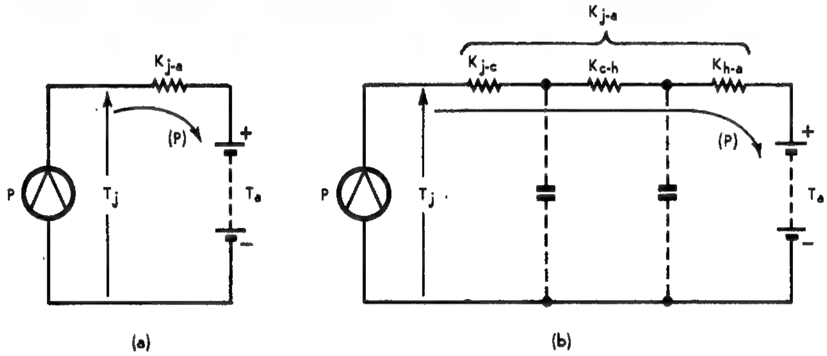
Naturally external circuit conditions can play a part in determining which of the two breakdown mechanisms occurs first, because as we have seen in the foregoing the avalanche voltage is quite dependent upon base-emitter bias. Hence with some dvices punch-through can occur if the base is reverse biased or effectively shorted to the emitter (BVcev > Vpt, or BVces > Vpt), but cannot occur if the base is effectively open circuited (Vpt > BVceo).

There is a third type of bipolar transistor breakdown mechanism which is quite distinct from both the avalanche and punch-through mechanisms. This is the so-called **second breakdown** mechanism.

In contrast with the avalanche and punch-through mechanisms, which are basically voltage-dependent, the second breakdown mechanism is primarily a function of localised power dissipation and overheating in the collector-base junction depletion layer.

The cause of second breakdown lies partly in the fact that the lightly doped base region of all practical bipolar transistors possesses significant "transverse" resistance, or resistance in the effective cross-section of the base. This is true regardless of the particular doping levels and internal geometry employed. And one direct implication of the transverse base resistance is that any external bias applied to either device junction is never applied entirely uniformly; a potential gradient is always set up through the base region, causing the effective bias to be greater in some areas than in others.

Because of this effect, the current passing through practical bipolar devices is not distributed evenly throughout the cross-sections of the emitter and collector junctions, but tends to concentrate in a manner reflecting the non-uniform effective bias. Thus with most modern devices having an internal structure roughly circular in shape, current tends to concentrate around the periphery of the junctions under forward bias conditions, while conditions of reverse bias tend to cause a concentration at the centre of the junctions.



Tj = JUNCTION TEMPERATURE Ta = AMBIENT TEMPERATURE

$K_{j\text{-}a} = \theta_{j\text{-}a}$ = THERMAL RESISTANCE BETWEEN JUNCTION AND AMBIENT

$K_{j\text{-}c} = \theta_{j\text{-}c}$ = THERMAL RESISTANCE BETWEEN JUNCTION AND CASE

$K_{c\text{-}h} = \theta_{c\text{-}h}$ = THERMAL RESISTANCE BETWEEN CASE AND HEATSINK

$K_{h\text{-}a} = \theta_{h\text{-}a}$ = THERMAL RESISTANCE BETWEEN HEATSINK AND AMBIENT

P = POWER DISSIPATED AT JUNCTION

Figure 11.2

Being reverse biased in normal operation, the collector-base junction of a device accounts for most of the collector-emitter voltage drop. Hence it is the collector-base depletion layer which accounts for most of the power dissipated by the device, and in this region that most of the heat is generated. The non-uniform distribution of device current produced by transverse base resistance therefore results in uneven generation of heat in the depletion layer.

As well, minor doping variations tend to occur almost inevitably, and these tend to cause further localisation of current and power dissipation. The result is "hot spots," or small areas within the collector junction depletion layer which have significantly higher dissipation than the remaining areas of the layer.

It is these hot spots which are associated with the second breakdown mechanism. In effect, what happens in second breakdown is that the temperature at one or more of the hot spots reaches a level where melting of other permanent changes to the device structure can occur. Generally this results in a sharp rise in collector-emitter current, a fall in voltage drop and the ruin of the device.

As one might expect, the actual tem-

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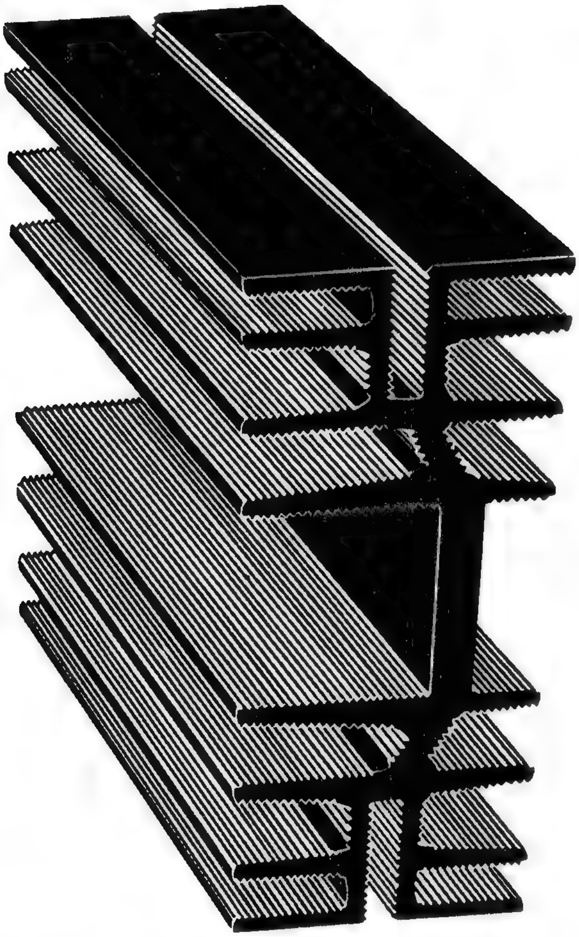

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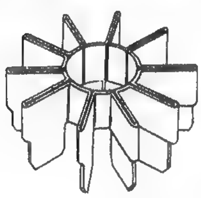

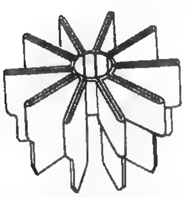

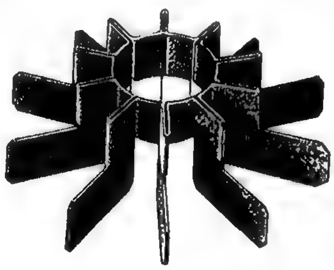

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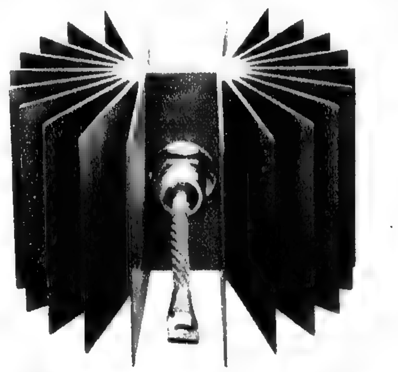

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perature reached by the hot spots within a device depends not only upon the total power dissipation but also upon the doping non-uniformity, the transverse base resistance and the way this causes current concentration under various bias conditions. It also depends upon the effective duty cycle of the applied power, and the thermal behaviour of the device structure.

From this it may be seen that second breakdown is a rather complex mechanism, depending upon quite a number of factors. Some of these factors are under the control of the device manufacturer, and considerable research is being directed toward their more effective control. However other factors are determined by circuit conditions and biasing, and must be taken into consideration by the circuit designer.

Note in passing that in contrast with the avalanche and punch-through mechanisms, second breakdown is not merely a mode of potentially high power dissipation, but is rather a situation in which permanent device damage occurs. Because of this it is very difficult to test a device for second breakdown without ruining it in the process. "Second breakdown test sets" have been developed, but these are quite elaborate systems which are designed to detect slight changes in device behaviour occurring just before permanent damage ensues.

As with the other semiconductor devices which we have examined, bipolar transistors are rated by the manufacturer in terms of a maximum allowable internal operating temperature. Such a rating takes into account both the ambient temperature in which the device is situated, and the temperature rise within it due to power dissipation.

As the collector junction depletion layer generally accounts for a major proportion of the total device dissipation, bipolar devices are usually rated in terms of collector junction temperature, symbolised Tj(max). Typically Tj(max) for germanium devices lies in the range 80-90°C, and for silicon devices in the range 150-180°C.

Needless to say, the actual collector junction temperature of a device cannot easily be measured, as the junction itself lies buried within the device chip or die. However, the temperature may be deduced from a knowledge of the ambient conditions, the power being dissipated, and the thermal characteristics of the device and its immediate surroundings.

As we have seen in an earlier chapter, it is possible to describe the steady-state thermal behaviour of a semiconductor device and its package in terms of a **thermal resistance.** This is simply a measure of the temperature rise as a function of power dissipated, being expressed in units of (°C/watt). If transient thermal conditions are to be encountered it is necessary to supplement knowledge of the device thermal resistance with details of its **thermal capacitances,** either directly or in terms of the thermal time-constants.

Prior to the dissipation of power, the collector junction and all other parts of a device are normally at the so-called "ambient" temperature — i.e., the temperature of the surroundings, or more strictly that of those parts of the surroundings whose thermal capacity is so large that their temperature is for all practical purposes independent of any change in the thermal state of the device itself. When power is dissipated in the device, then, its internal temperature rises from this reference level rather than from absolute zero.

The extent to which the temperature rises above ambient is found simply by taking the product of the power being dissipated by the device and the **total effective thermal resistance** between the internal junction and the ambient surroundings. The latter parameter is often symbolised **Kj-a,** the letter "K" being a general symbol for thermal resistance (the Greek symbol **theta** is used alternatively, and perhaps more commonly; however, this symbol is not available for the present text).

Hence under steady-state conditions, the actual operating temperature of the collector junction of a bipolar transistor may be found by adding the temperature rise to the ambient temperature:

$$Tj = Ta + P.Kj\text{-}a \qquad \ldots (11.1)$$

Here Tj represents the junction temperature, Ta the ambient temperature, P the power dissipation, and Kj-a the total effective thermal resistance between the junction and the ambient surroundings. Note that Kj-a will include not only the thermal resistance of the device itself, but also that which is effectively present between the device package and ambient.

Often it is convenient to rearrange the expression of (11.1) into the following form, which permits easy calculation of the **maximum** power which a device may be allowed to dissipate for a given ambient temperature:

$$Pmax = \frac{Tj(max) - Ta}{Kj\text{-}a} \qquad \ldots (11.2)$$

Here Pmax is the required maximum disipation figure, Tj(max) is the maximum junction temperature rating of the device, and Ta and Kj-a are the same as before.

The significance of expressions (11.1) and (11.2) may be seen quite clearly if the thermal situation involved is represented by a **thermal equivalent circuit.** This is a schematic diagram drawn using electrical symbols to represent thermal parameters, and based upon the fact that most thermal parameters behave in a very similar way to certain electrical parameters.

Thus the heat energy produced by power dissipation tends to "flow" through components in much the same way as an electrical current, interacting with the thermal resistances of the components to produce temperature drops in a very similar way to the voltage drops produced across electrical resistors.

The situation expressed in (11.1) may thus be represented by the simple thermal equivalent circuit of figure 11.2 (a).. Here the constant current generator represents the constant power P dissipated in the device junction, while

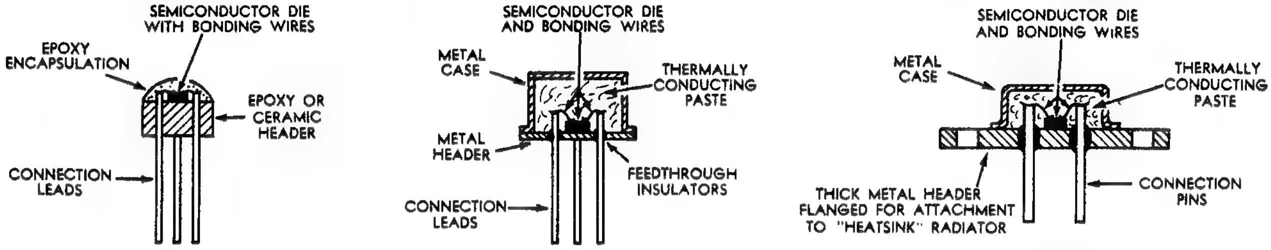

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Figure 11.3

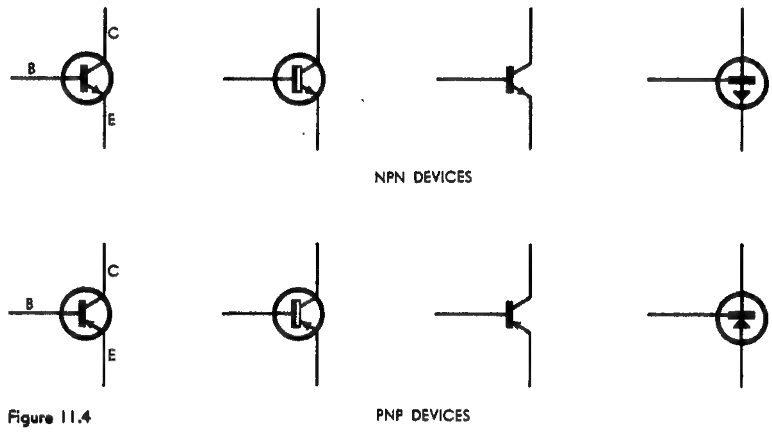

Figure 11.4

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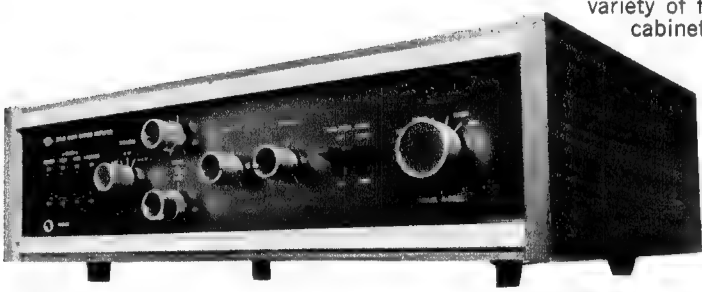

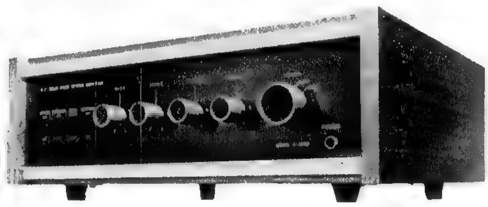

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SPECIFICATIONS

Output Power: 80 watts (total IHF music power into 8 ohms); 30 watts RMS each channel into 8 ohms
Harmonic Distortion: 0.2% (at 25 watts output level)
Power Bandwidth: 20—30,000 Hz (-3dB; 0.5% distortion)
Frequency Response: 15—40,000 Hz (-2dB)
Channel Separation: Over 50 dB
Output Impedance: 4—16 ohms
Damping Factor: 32 (8 ohms); 64 (16 ohms)
Hum and Noise: Over 60 dB (Phono). Over 76 dB (AUX).
Input Sensitivity: 3mV (Phono); 2mV (Tape HD); 260mV (Tape In); 260mV (AUX; TUNER)
Tape Out: 100mV
DIN Jack Sensitivity: 260mV for Tape In; 30mV Tape Out
Tone Controls and Switches: Bass 50 Hz ± 12 dB; Treble 10,000 Hz ± 10 dB; Loudness 50 Hz + 12dB; 10,000 Hz + 4 dB; Hi Filter 10,000 Hz - 12 dB; Low Filter 50 Hz - 10 dB
Power Consumption: 100 VA
Power Source: 117V, 220V, 240V

—MONARCH A-3000 R.R.P. $144

FACILITIES

Front Panel: Selector—Aux; Tuner; X'tal; Phono • Volume • Balance • Treble • Bass • Loudness • Mode — Stereo/Mono • Tape Monitor • Power • Phones Jack
Rear Panel: Input — Mag; X'tal; Tuner; Aux; Tape Input • Tape Output • Speaker Terminal • AC Outlet • Line Fuse

SPECIFICATIONS

Output Power: 50 watts total music power (IHF) into 8 ohms; 18 watts RMS each channel into 8 ohms
Harmonic Distortion: 0.5% (at 15 watts output level)
Frequency Response: 20 to 35,000 Hz
Power Bandwidth: 20 to 30,000 Hz (-3 dB; 0.5% distortion)
Channel Separation: Over 50 dB
Hum and Noise: Over 60 dB (MAG); 65 dB (AUX)
Loudness: 50 Hz + 12 dB; 10 KHx + 3 dB
Tone Control: BASS 50 Hz + 14 dB — 12 dB. TREBLE 10 KHz + 12dB — 14dB
Input Sensitivity: MAG 2.5 mV; X'TAL 250 mV; AUX 180 mV; TUNER 180 mV
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the battery represents the constant temperature Ta of the ambient surroundings. The resistor represents the thermal resistance Kj-a between junction and ambient. It may be seen that the junction temperature Tj, shown as equivalent to a voltage, will be equal to the sum of Ta and the temperature drop in the resistor, given by (P.Kj-a).

Typical packages used for bipolar transistors (and other devices) are shown in figure 11.3. As may be seen, small epoxy-resin packages are used for low power devices, while larger metal packages are used for higher power devices.

Low-power devices in small epoxy and metal cases are normally operated without any provision for heat removal additional to that provided by radiation and convection from the device itself, and because of this the thermal resistance figure generally specified by the manufacturer for these devices is, in fact, Kj-a, the complete "junction-to-ambient" thermal resistance. Naturally, this is an "average" figure representing a typical device in a typical thermal situation.

Because of the relatively low thermal coupling between a small package and the surroundings, the Kj-a for typical low-power devices tends to be rather high: in the range 250-600°C/watt. From expression (11.2) it may be appreciated that this tends to limit the power dissipation of even silicon devices to a few hundred milliwatts at normal ambient temperatures, and to proportionally lower power levels at elevated temperatures.

Higher power devices are not normally operated "free-standing," but rather with provision for additional heat removal via either a clip-on metal fin radiator, or a large "heatsink" radiator to which the device case is bolted. For these types of device the manufacturer therefore cannot in general predict the total effective junction-to-ambient thermal resistance Kj-a, because this will consist in part of the thermal resistance associated with the additional heat removal components.

This being the case it is usual for the manufacturer to specify for high power devices the **junction-to-case thermal resistance**, symbolised **Kj-c.** This parameter typically varies within the range 6—40°C/watt for medium power devices, and within the range 0.5 — 4°C/watt for high power devices.

In order to calculate the operating junction temperature or the maximum power dissipation for a higher power device, using expressions (11.1) and (11.2), it is necessary to work out the total effective junction-to-ambient thermal resistance Kj-a. This is simply a matter of adding to the figure of Kj-c provided by the manufacturer the additional thermal resistances effectively present between the device case and ambient. Expressed symbolically:

$$\text{Kj-a} = \text{Kj-c} + \text{Kc-h} + \text{Kh-a} \quad \ldots (11.3)$$

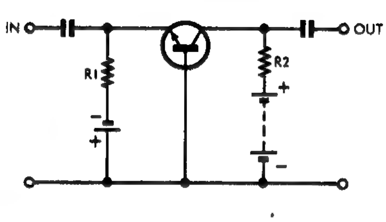
where Kc-h represents any effective thermal resistance between the device case and the heatsink (mica insulating washers, etc.), and Kh-a represents the effective thermal resistance to ambient provided by the heatsink.

The significance of expression (11.3) may be seen in figure 11.2(b), where the simple thermal equivalent circuit of (a) is expanded to account for the distinct thermal resistances which together form Kj-a in the case of a high power device mounted on a heatsink. The individual thermal resistances are shown in series, to agree with the observed fact that their temperature drops are additive.

The approximate thermal resistance of different mounting configurations, insulating washers and heatsinks are given in many of the standard design manuals. This allows quite accurate predictions to be made of operating temperatures for higher power devices, and conversely it permits the designer to estimate quite accurately the type and size of heatsink required if a device is to be called upon to operate reliably at a given power dissipation.

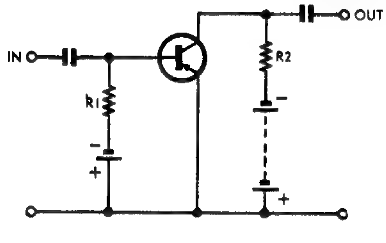
As with most other semiconductor devices, bipolar transistors are in practice usually given both **average current ratings** and **surge current ratings.** In many cases, such ratings are given individually for each of the three device electrodes, to allow for situations in which the normal current relationships of the device are disturbed by transient conditions, breakdown or overdrive.

There is no single, specific breakdown mechanism associated with high device current levels as such. The current ratings which a manufacturer assigns to his devices are based upon consideration of one or more of a number of somewhat unrelated factors such as the fusing current of small internal bonding wires, and the fall-off in device amplification at high current levels due to dropping emitter injection efficiency and increased recombination in the base region.



COMMON BASE AMPLIFIER
(NPN DEVICE SHOWN)

Figure 11.5 (a)



COMMON EMITTER AMPLIFIER
(PNP DEVICE SHOWN)

(b)

It should perhaps be stressed that expressions (11.1) and (11.2) are only valid for steady-state conditions, as they take only thermal resistances into account. For accurate prediction of the temperature of a device under transient conditions, it is necessary to expand the foregoing discussion to take into account the effect of thermal capacitances.

The dashed capacitor symbols on figure 11.2 (b) indicate the basic effect of the thermal capacitances possessed by the device itself and the mounting arrangements. As may be seen, these introduce multiple thermal time-constants which will naturally tend to slow down any tendency for junction temperature Tj to change with changes in power dissipation P. Unfortunately a full discussion of the effects of thermal capacitance is beyond the scope of the present treatment, but this may give the reader some insight into the concepts involved.

Before leaving the topic of device temperature and power dissipation the reader may care to note that the foregoing discussion does not by any means apply solely to bipolar transistor devices. In fact it applies to virtually all electronic devices which dissipate power in operation, and hence to virtually all semiconductor devices. The concepts concerned have been developed in the present chapter simply because bipolar devices are those most often encountered at present in medium and high power applications.

From the preceding discussion of voltage breakdown, second breakdown, and temperature and power dissipation ratings for bipolar transisitors, the reader may perhaps have been led to infer that these devices might not be given specific ratings concerning current levels. On the surface this might seem a reasonable inference, based on the assumption that a device should not be damaged by any current level corresponding to operation within the second breakdown and Tj(max) ratings. However this is not the case.

Having looked in the foregoing at the main ratings which apply to bipolar transistors, let us now turn to consider further noteworthy aspects of normal device behaviour. To begin this section the reader may care to note the schematic symbols commonly used to represent bipolar transistors in circuit diagrams. These are shown in figure 11.4, where it may be seen that despite minor differences between symbols, the "arrowhead" on the emitter lead always points away from the rectangular bar base symbol for NPN devices, and toward it for PNP devices.

It may be recalled from the preceding chapter that the amplification action of the bipolar transistor essentially involves the modulation or control of collector junction current by the bias conditions at the base-emitter junction. Hence when considered as an amplifying device, it is the base and emitter electrodes which form the "input" terminals. As the base-emitter junction is normally forward biased, this means that the bipolar transistor is characterised by a relatively **low input impedance.**

The effective resistance of a forward biased P-N junction is a function of the current flowing, as the reader may care to determine by referring back to figure 5.1. The resistance is high at very low current levels, falling rapidly as the internal potential barrier is surmounted and the junction "turns on".

Surprisingly, perhaps, the actual resistance value of all forward biased P-N junctions as a function of absolute temperature and current flowing is remarkably consistent. It is virtually independent of doping levels, junction size and geometry. The theoretical reasons for this are a little beyond the scope of the present treatment; however the theory does predict that effective junction re-

sistance should be directly proportional to temperature yet inversely proportional to current, and this is in fact what is found.

The emitter junction of a bipolar transistor is no exception to this rule. Hence it is found that the effective resistance of the emitter junction of virtually any bipolar transistor at normal temperature (25°C) can be predicted quite closely by the simple expression:

$$Re = \frac{26}{Ie} \quad \ldots (11.4)$$

where Ie is the emitter current in milliamps.

When a bipolar transistor is used as an amplifier in the common-base configuration, as illustrated in figure 11.5(a), it is the value of junction resistance given by the foregoing expression which forms the effective input resistance of the device. This is because the current flowing in the input circuit is the full emitter current Ie. Hence in this configuration the device tends to have a very low input resistance; for example if the quiescent emitter current is a modest 1mA the input resistance will be only 26 ohms.

A somewhat higher, although still only moderate, input resistance is presented by the device when used in the common-emitter configuration of figure 11.5(b). Here there is an effective multiplication of the effective emitter junction resistance seen by the input circuit, because the current flowing in this circuit is the base current Ib, representing the relatively small current component $Ie.(1 - \alpha)$.

The effective input resistance of the junction itself in this configuration is thus equal to $Re/(1 - \alpha)$, and since alpha is very close to unity for most transistors, this is for practical purposes equal to (β.Re). For most practical devices one must add to this value the effective series resistance of the base region, so that the total input resistance of a bipolar transistor in the common-emitter configuration can usually be predicted quite closely by the expression:

$$Rbe = \beta.Re + Rbb \quad \ldots (11.5)$$

where Rbe is the common-emitter input resistance, Re is the junction resistance given by (11.4), and Rbb is the base region "spreading resistance."

From this it may be seen that the higher the gain of a device, the higher its input resistance in the common-emitter configuration. Also since Re is inversely proportional to emitter current Ie, according to expression (11.4), the input resistance tends to rise as Ie is reduced. However, the latter tendency is complicated by the fact that the amplification action of the bipolar transistor itself varies with emitter current.

As we saw in the preceding chapter, the amplification tends to fall at high current levels as a result of minority carrier concentration in the base region, and a consequent lowering in emitter injection efficiency. In fact, the amplification also tends to fall at very low current levels, particularly with silicon devices.

The full explanation of this is rather complex, and beyond the scope of the present treatment. However, in basic terms, what happens is that the small number of carriers injected into the base at very small emitter current levels cause a relatively weak concentration gradient, and thus tend to diffuse away through the base at quite a low velocity. This prolongs the time required to reach the collector junction depletion layer, and hence results in an increase in recombination with base region majority carriers. Hence the base transport efficiency is reduced, and with it the overall amplification.

This mechanism actually operates for both germanium and silicon devices. However, with silicon devices there is an additional mechanism which tends to reduce the gain at low current levels. The mechanism is associated with so-called "recombination centres" which tend to be present in the depletion layer region of the emitter junction, consisting of unwanted impurity atoms and various types of structural defect present in the crystal lattice.

The action of the recombination centres is to "grab" diffusion current carriers crossing the depletion layer from the emitter, and hold them captive so that they tend to be met by their opposite numbers travelling from the base. The net result is that the "useful" emitter-to-base injection component of emitter current is reduced, while the non-useful component in the opposite direction is increased; in other words, the emitter injection efficiency is lowered.

As the number of carriers involved in this mechanism is essentially fixed by the number of recombination centres present in a device, the effect upon emitter injection efficiency becomes significant only at low current levels where these carriers form an appreciable fraction of the total emitter current. At higher current levels the effect is swamped.

Because silicon devices offer many advantages in terms of low leakage currents and the ability to operate at elevated temperatures, device manufacturers have directed considerable effort toward reducing this effect. By stringent quality control of semiconductor materials and fabrication processes they have been able to reduce the number of recombination centres present in modern silicon devices to a very low level, resulting in β values as high as 300 at current levels as low as 10uA.

Naturally enough, devices capable of providing this order of current amplification at such low operating current levels are attractive from this viewpoint alone, as low operating currents generally mean higher efficiency and low circuit noise. However, reference to expressions (11.4) and (11.5) in the foregoing shows that such devices also offer the advantage of very high input resistance. At an emitter current level of 10uA, Re has a value of 2600 ohms, so that a device with a beta of 300 at this current level will display an input resistance of around 780K in the common-emitter configuration.

The variation of current gain β with emitter current level for a typical modern silicon bipolar transistor is illustrated in figure 11.6. It may be seen that the gain drops relatively slowly at low current levels, due to the influence of the recombination centres in the emitter junction depletion layer, and more rapidly at high current levels due to the effects of minority carrier concentration in the base.

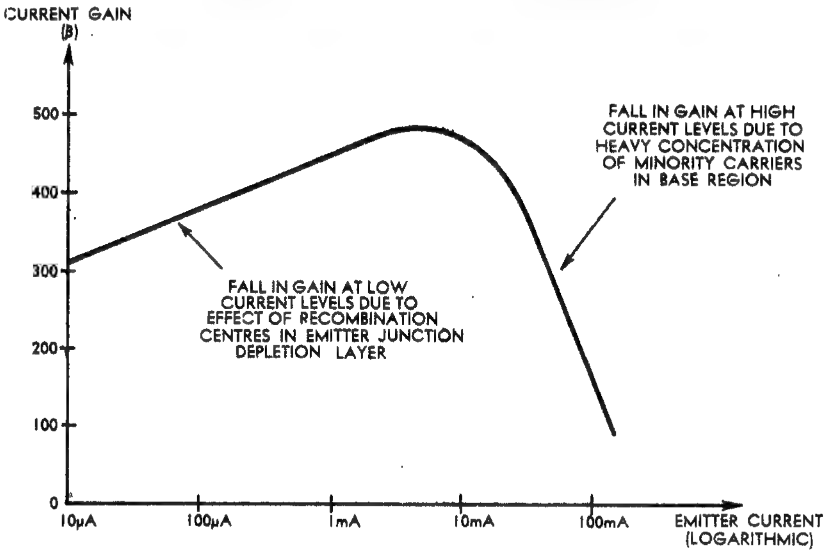


Figure 11.6

In passing, it may be worthwhile to point out that the **output resistance** of a bipolar transistor is basically the high resistance associated with the reverse biased collector-base junction. With modern low-leakage silicon devices this is typically around 1 megohm, whereas with the higher leakage germanium devices it is typically in the order of a few hundred kilohms.

Because of the relatively high input and output resistances displayed by modern silicon transistors, particularly in the common-emitter configuration, it is often convenient to visualise the amplification action of these devices not in terms of current gain, but rather in terms of an equivalent **transconductance** relating input base-emitter voltage with output collector current.

It is fairly easy to express the amplification of a bipolar device in terms of a transconductance, because the input voltage and current are related by the effective input resistance. In fact simple calculations based only on Ohm's law and expressions (11.4) and (11.5) show that for **both** the common-base and common-emitter configurations, the transconductance is almost exactly equal to the reciprocal of the emitter junction resistance Re.

The calculations for the common-

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emitter configuration are as follows, shown for illustration:

$$Vin = Iin.Rin = \frac{Ib.Re}{(1 - \alpha)}$$

$$Iout = Ic = Ib.\beta = \frac{Ib.\alpha}{(1 - \alpha)}$$

$$\text{thus } gm = \frac{Iout}{Vin} = \frac{\alpha}{Re} \cong \frac{1}{Re} \quad \ldots (11.6)$$

The reader may care to verify that this result is also obtained for the common-base configuration.

What do these results actually mean? Simply that the transconductance of bipolar transistors, like the emitter junction resistance, is basically almost independent of device variations. The transconductance of virtually any bipolar transistor at normal temperature may thus be predicted simply by finding the reciprocal of Re, which from expression (11.4) is a simple function of the emitter current Ie. Hence at an emitter current of 1mA, the transconductance of any bipolar transistor is approximately 38.5mA/V, or in other words 38.5 milliMhos.

Actually, because the calculations leading to the expression of (11.6) are based on simplified theoretical assumptions, this expression tends to be over-optimistic in predicting gm. In practice it is found that the transconductance of most bipolar transistors is about 20 per cent lower than the predicted value, or equal to approximately (0.8/Re).

To conclude this discussion of the ratings and characteristics of practical bipolar transistors, let us now look briefly at the topic of **device frequency response.**

As with virtually all other "active" electronic devices, the behaviour of practical bipolar transistors is dependent upon frequency. In general, the performance of all devices tends to deteriorate as the operating frequency is raised. Various device types and individual devices differ only in terms of the rate of deterioration and the actual frequencies at which the performance is reduced to a nominal level.

The reasons for the fall-off in device performance at high frequencies are many. One important factor is that injected carriers take a finite time to diffuse across the base region — the so-called **base transit time.** At frequencies where this transit time becomes a significant proportion of the signal cycle, the carriers crossing the base region become "out of step" with the potential gradient across the region, resulting in a higher incidence of recombination. Base transport efficiency drops, and with it the device amplification.

The base transit time can naturally be lowered by reducing the physical thickness of the base region, and devices intended for use at very-high and ultra-high frequencies are generally provided with the thinnest base regions which can be reliably fabricated. It is also common to employ the NPN configuration for such devices, because the higher mobility of electrons results in a lower base transit time for a given base thickness than with the holes of a PNP device.

Other important factors influencing high-frequency performance are the space charge or **transition capacitances** associated with the depletion layers of the emitter and collector junctions. Together with the effective resistances of the junctions themselves, and also with the inevitable "bulk" or "spreading" resistances of the main emitter, base and collector regions, these depletion layer capacitances form R-C timeconstants which generally act as low-pass filters.

A further factor influencing bipolar device frequency response is the transit time taken by collected carriers to drift across the collector junction depletion layer. Although generally quite short compared with the base transit time, this further transit time can be significant with some very high frequency devices.

Possibly the perceptive reader will have realised from the foregoing that many of the factors which influence the frequency response of a bipolar device are themselves variables which depend upon the voltage and current levels at which the device is operated. Hence the frequency response of a device is not fixed, but is, in fact, dependent upon the operating conditions.

Thus, because base transit time depends upon the **effective** base region thickness, it is actually determined just as much by the width of the encroaching collector junction depletion layer, as by the physical base thickness. As a result, the base transit time of a device tends to increase significantly at low collector-emitter voltages, due to the relatively narrow depletion layer.

On the other hand, the widened collector junction depletion layer at high collector-emitter voltages itself tends to cause an increase in the depletion layer transit time. Base transit time and collector junction depletion layer transit time are thus complementary functions of collector-emitter voltage, each tending to cause a deterioration in frequency response at opposite voltage extremes.

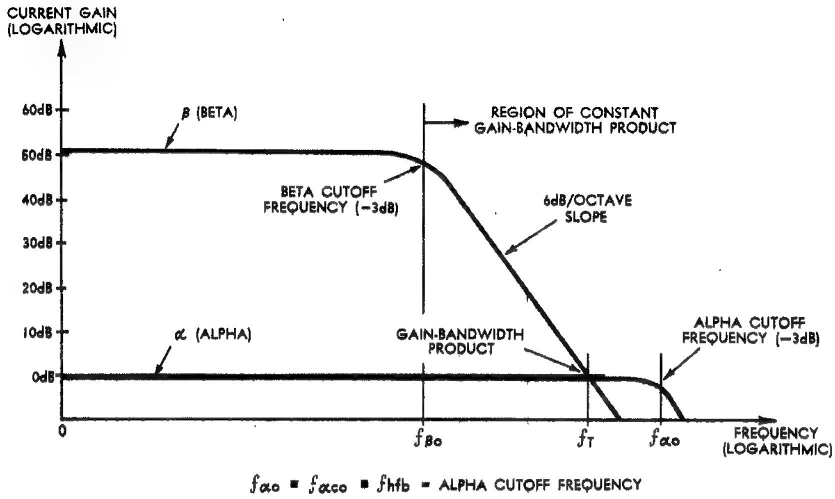

Figure 11.7

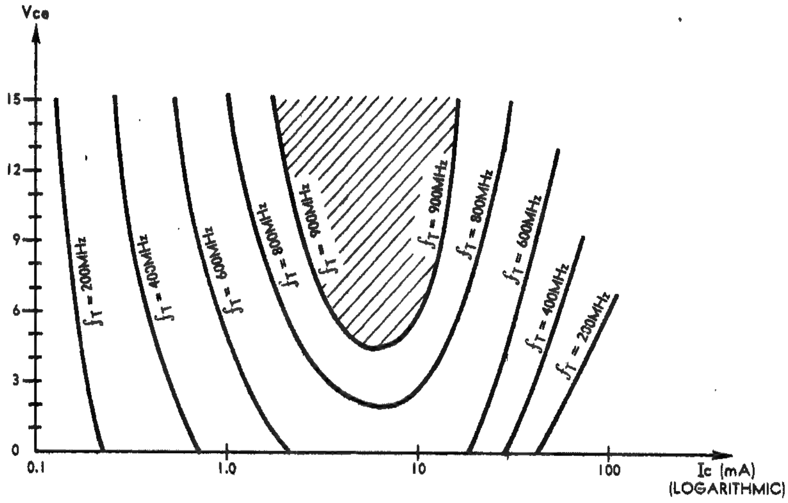

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Figure 11.8

Naturally, the collector-emitter voltage also determines the capacitance of the collector junction depletion layer, as this, too, depends upon the depletion layer width. Low values of collector voltage thus tend to reduce frequency response fairly rapidly because of the combined effects of increased base transit time, and increased collector junction capacitance. High values of collector voltage cause a somewhat less rapid deterioration due to rising collector junction transit time. The net effect is that the frequency response of a bipolar device tends to be highest at moderate collector voltage levels.

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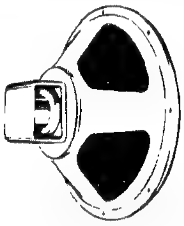

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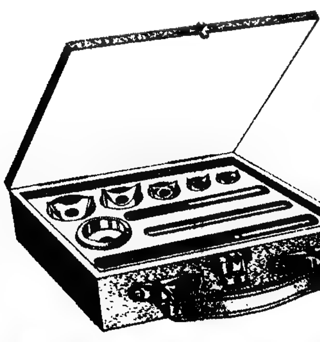

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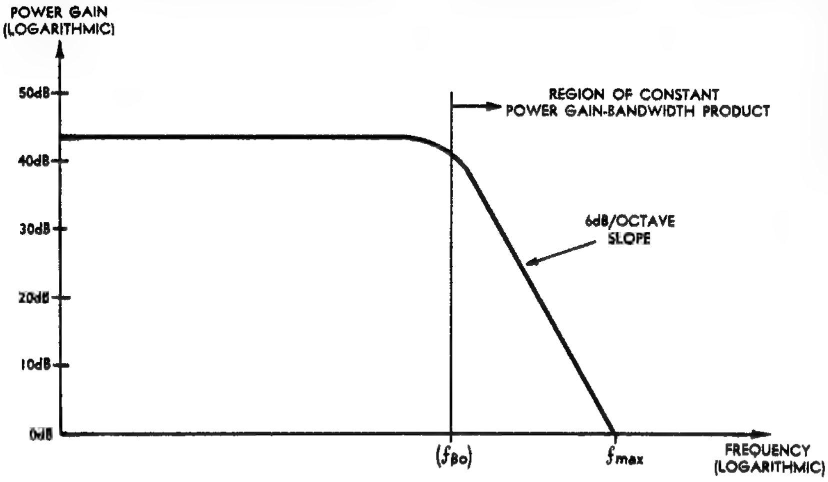
The frequency response of a device tends to fall at low current levels, due to the rise in emitter junction resistance Re according to expression (11.4). This produces a long emitter junction time-constant, as the depletion layer capacitance of this junction is quite high under normal forward bias conditions.

There is also a slow drop in frequency response at high current levels, due primarily to the drop in effective collector junction bias caused by voltage drop in the semiconductor material of the collector region. The lower effective bias at the collector junction causes a contraction of the depletion layer as before, and a reduction in frequency response due to increased base transit time and collector junction capacitance.



$f_{max} = f_{osc} = f_o$ = "POWER GAIN CUTOFF FREQUENCY" (POWER GAIN-BANDWIDTH PRODUCT) = MAXIMUM FREQUENCY OF OSCILLATION

Figure 11.9

The frequency response of a bipolar transistor thus tends to be most favourable at operating points involving moderate voltage and current levels. At such operating points, the response tends to roll off smoothly in much the same manner as a simple R-C filter. The roll-off becomes apparent and/or significant in a number of ways, depending upon the circuit configuration in which the device is used, and the application.

In terms of the common-base amplification factor alpha, the performance of a device remains substantially constant up to a "corner" or "turnover" frequency, above which alpha falls logarithmically at the familiar 6dB/octave (20dB/decade) rate. This corner frequency, at which alpha has a value of 0.707 (—3dB) of its low-frequency value, is known as the **alpha cutoff frequency** of a device.

Like alpha, the common-emitter amplification factor beta also tends to remain constant up to a corner frequency, and then fall at 6dB/octave. However, because beta is a more sensitive indicator of device behaviour, and also because it is more sensitive to phase-shift effects, the **beta cutoff frequency** is generally very much lower than that for alpha. In fact, for typical devices it varies between $1/2\beta$ and $1/\beta$ of the alpha cutoff frequency. From this it may be seen that the higher the gain of a device, the lower tends to be its beta cutoff frequency as a fraction of the alpha cutoff frequency.

There are two broad implications from the foregoing. One is that because the beta cutoff frequency tends to be inversely proportional to beta itself, it is generally necessary to use low or medium-gain devices in a common-emitter amplifier stage in order to realise the maximum bandwidth. The other implication is that if the maximum bandwidth of a particular device is to be realised, it is generally necessary to use the common-base configuration in preference to common-emitter.

Because the beta of a device falls logarithmically above the beta cutoff frequency, the rate of gain fall-off in this region is such that the product of beta and frequency is always constant. Accordingly this region of device operation is often described as that wherein a device displays a constant "gain-bandwidth product."

The actual value of the gain-bandwidth product of a device in this region varies from device to device, and is in fact a very useful parameter of overall high frequency performance. At the same time it is conveniently measured because naturally enough its value is numerically equal to the frequency at which beta has fallen to unity. Because of this the latter frequency is often simply called the **gain-bandwidth product.**

The gain-bandwidth product of a device is generally in the same order as the alpha cutoff frequency, although usually below it. The relationship between the two parameters is not a simple one, however, and varies between devices and device types. The general relationships between alpha cutoff frequency, beta cutoff frequency and gain-bandwidth product are shown graphically in figure 11.7, together with the various symbols used for these parameters.

As noted earlier, the frequency response of a bipolar device depends not only upon the device itself, but upon its operating voltage and current levels. This dependence is conveniently expressed in terms of the gain-bandwidth product, as illustrated in figure 11.8.

Here are drawn the so-called **contours of constant gain-bandwidth product** for a typical modern silicon NPN transistor, expressing the way in which the gain-bandwidth product of the device varies with operating voltage and current. It may be seen that the maximum value of gain-bandwidth product for the device concerned is 900MHz, which may only be realised at operating points within the shaded region. Outside this region the gain-bandwidth product drops, as indicated by the frequency on the remaining contours.

Even at frequencies above the gain-bandwidth product and the alpha cutoff frequency, a bipolar transistor may be capable of useful power gain by virtue of the impedance step-up between input and output. In other words, a device can still have a useful power gain even at frequencies where its common-emitter current gain has dropped below unity.

In fact the power gain has a similar frequency characteristic to that for current gain, as may be seen from figure 11.9. Above the beta cutoff frequency, it falls logarithmically with frequency to give a constant power gain-bandwidth product. As before the power gain-bandwidth product is conveniently defined in terms of the frequency at which the power gain has fallen to unity (0dB), in this case known as the **power gain cutoff frequency.**

The power gain cutoff frequency is again a very useful parameter of high frequency performance, because it represents the highest frequency at which the device may be used to obtain power gain. It also represents the absolute maximum frequency at which the device concerned may be used in an oscillator, and for this reason it is alternatively known as the **maximum frequency of oscillation.**

There are other parameters used to indicate the high frequency performance of a bipolar transistor, including parameters which relate to the behaviour of the device as an "on-off" switch as distinct from its use as a (nominally) linear amplifier. However, the parameters described in the foregoing are those most often encountered, and should give the reader at least a basic insight into device behaviour.

SUGGESTED FURTHER READING

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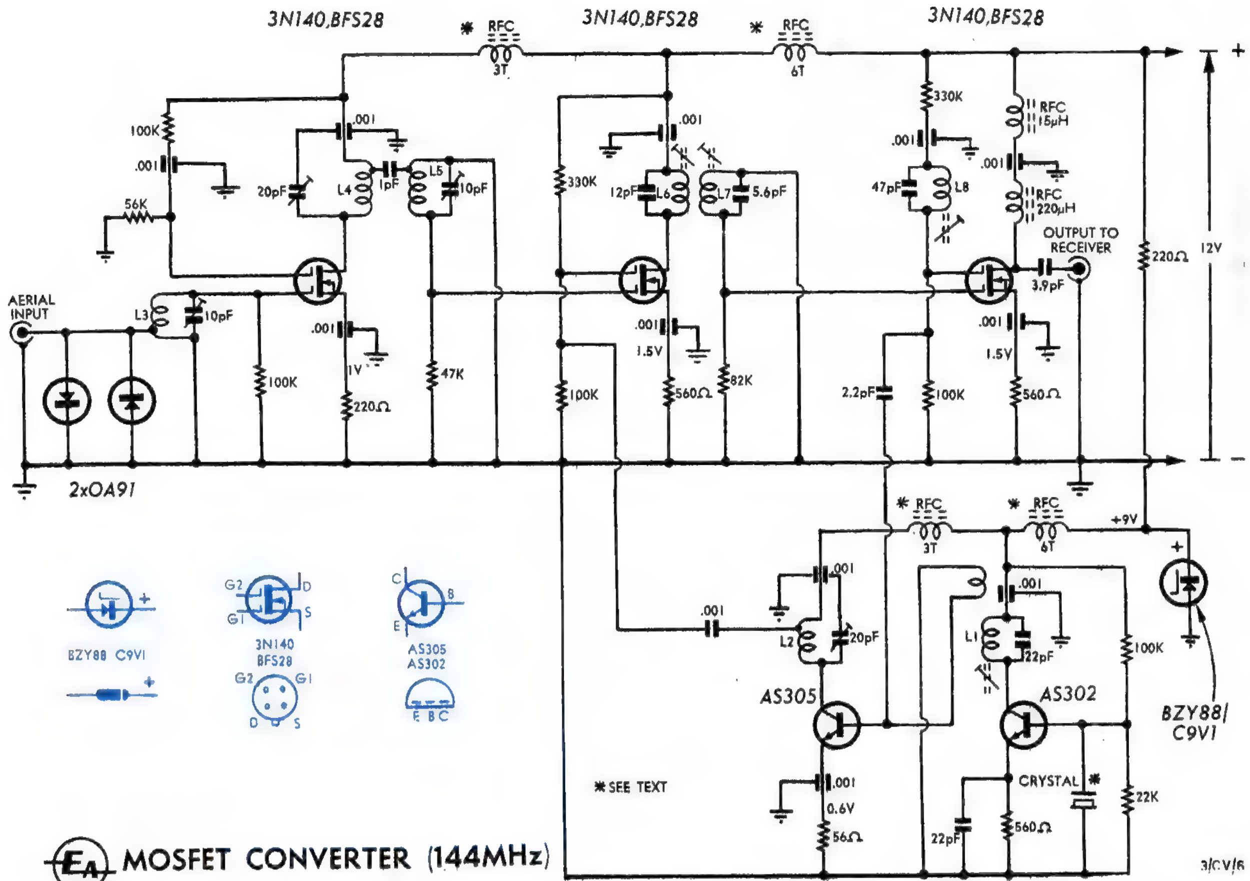


MOSFET CONVERTER (144MHz)

The circuit of the converter, shown above, may be divided into five sections corresponding to each transistor as shown in the block diagram of figure 2. Note the correct transistor base and diode connections, shown in blue.

to the actual received signal level, than at lower frequencies.

Because of the gain contributed in practice by the converter to the overall receiving system, consisting of converter plus receiver, noise generated in the receiver is generally not significant. The signal level at the output of the converter is usually very high with respect to the noise level within the receiver, so that the noise performance of the overall receiving system is determined almost entirely by the converter.

It is possible to measure the noise contributed by the converter in terms of a conventional signal-to-noise ratio, which when actually measured is the ratio of signal-plus-noise to noise, expressed in decibels. Because the expression is given as a ratio, the signal level at the input must be stated also, so that the noise voltage may be calculated. In other words, the figure in decibels is dependant upon the signal level used to measure the ratio.

However, there is another way of specifying the noise performance of a converter which is not dependant upon the signal level at the input. With such a specification of noise it is easy to make objective comparisons between various converters without reference to the signal level used for measurement. Such a description of noise performance is termed "noise figure."

Noise figure has been defined as the ratio between the signal-to-noise ratio at the output of a hypothetical ideal converter (or receiver), and the signal-to-noise ratio at the output of the actual converter under test. This simply means that noise figure is a comparison of the noise performance of any equipment with the "ideal" device as a standard.

However, this can be defined alternatively as the ratio of the signal to noise ratio at the input of the converter under test, and the signal-to-noise ratio at the output of the same converter. Or, in other words, "by how much does the converter degrade the input signal-to-noise ratio?"

In the past, a noise figure of about 5dB has been typical of a valve converter using a triode as the RF amplifier with a pentode giving a somewhat higher figure. However, with modern premium quality triodes such as the "nuvistor" types it is possible to obtain a noise figure as low as 3.5dB to 4dB.

While triode RF amplifiers are generally preferred to pentodes because of their better noise figures, it is usually necessary to neutralise feedback capacitance inherent in the triode valve so as to avoid instability. Yet in practice correct neutralisation can be quite critical in adjustment and, therefore, difficult to obtain.

By connecting two triodes in series, in what is known as the "cascode" configuration it was found possible to avoid neutralisation. The first triode is connected in the grounded cathode configuration with input signal applied to its grid, while the second triode is connected in the grounded grid configuration with its cathode coupled to the plate of the first valve.

In this configuration, the grounded grid of the second triode behaves as a shield between the tuned input and tuned output of the composite RF amplifier. Thus, the use of two triodes results in a stable amplifier with a minimum noise figure.

With modern silicon bipolar transistors, it is possible to obtain even lower noise figures than was possible with valves. However, a serious disadvantage of bi-polar transistors is that they can cause considerable cross-modulation when handling large signal levels, and again they often require neutralisation for stable operation in high gain RF amplifiers.

The advent of field effect transistors (FETs), with their square-law transfer characteristic, provided considerable improvement in cross-modulation performance while still retaining low noise characteristics. But again, these devices generally require neutralisation and/or special circuit configurations.

As a development from the single gate FET devices, dual gate MOSFET (metal oxide silicon field effect transistor) devices have the advantages of extremely low noise, good cross-modulation characteristics and very small feedback capacitances, the latter obviating the need for neutralisation and special circuit configurations. Dual gate devices are now available at a very modest cost; the particular types we have used here are around two dollars.

With its second gate grounded, a dual gate FET is in fact very similar in operation to a two triode cascode configuration, being electrically equivalent to two single gate devices connected in series. The second FET gate being grounded again provides good isolation between input and output circuits in an RF amplifier. Thus, in effect, a single dual gate MOSFET can provide a complete cascode stage.

By using this type of "dual-gate MOSFET cascode" stage as the RF amplifier in our new converter design, we have been able to achieve quite outstanding performance. The RF stage gives the converter a high signal gain, a low cross-modulation characteristic, and a very impressive noise figure of better than 2dB.

The fundamental operation of the new converter may be seen from the block diagram of figure 2. As may be seen, we have used a system of double conversion requiring two mixing stages and two different injection frequencies. However the two injection frequencies are both derived from one crystal oscillator, so avoiding the use of two crystals.

In developing the unit we decided in favour of a double conversion system in view of the high conversion ratio in going from 144MHz to 3.5MHz. In addition to providing greater gain, the system provides more effective suppression of unwanted image frequencies and results in a band-pass shape having significantly better "skirt selectivity" than would otherwise be the case.

Signals from the aerial are amplified by a single stage RF amplifier from where they are introduced to the first mixer stage, still at a signal frequency of between 144MHz and 148MHz. An injection frequency of 105.375MHz in the first mixer heterodynes with the signal to produce a first IF in the range 38.625MHz to 42.625MHz.

The injection frequency for the first mixer is derived from a crystal controlled local oscillator at 35.125MHz followed by a tripling stage multiplying to 105.375MHz. The local oscillator frequency itself provides the injection frequency for the second mixer stage.

The oscillator frequency of 35.125MHz heterodynes with the first intermediate frequencies between 38.625MHz and 42.625MHz, in the second mixer, to produce a second IF of between 3.5MHz and 7.5MHz. It is this latter signal band which forms the converter output and is fed to the receiver or "tuneable IF."

The selection of 3.5MHz to 7.5MHz as the tuneable IF range was made on the basis that it includes the high frequency amateur bands of 3.5MHz to 3.7MHz (80 metres) and 7.0MHz to 7.15MHz (40 metres). Thus a tuneable IF designed specifically for use with the converter could also be used as a receiver for the abovementioned frequencies. We may describe such an IF-cum-receiver of modern design in a future issue ,if there appears to be sufficient reader interest.

In a double conversion system such as we are using, there are a number of possible crystal frequencies which will provide the same IF tuning range. For instance, a frequency of 46.833MHz could have been used but this would put the first IF within the six metre amateur band, with the consequent risk of receiving interfering signals from that band.

Alternatively, a crystal frequency of 28.1MHz could have been used, but this would require four times multiplication to arrive at the correct injection frequency for the first mixer. As four times multiplication generally requires two multiplier stages in order to obtain sufficient injection voltage at the required frequency, we have rejected this alternative in order to keep the converter as simple as possible.

We suggest that readers and constructors therefore regard as fixed the basic system involving an oscillator and a single stage frequency tripler. However, it is possible and quite in order to make slight variations in oscillator frequency in order to adjust the tuneable IF range to suit particular requirements. For example, if readers already have a receiver which covers says, 6MHz to 10MHz then the crystal frequency may be altered to suit.

The required crystal frequency may be calculated from the simple expression shown below, where "x" is the crystal frequency in MHz and "y" is the desired IF, in MHz, corresponding to 144MHz.

$$x = \frac{144 - y}{4}$$

In the case of the 3.5-7.5MHz output range which we have designed for in the prototype converter, this expression gives a crystal frequency of 35.125 MHz.

Looking at the circuit diagram, readers will note that the various semi-conductors are in a configuration similar to the sections of the block diagram shown in figure 2. An AS302 transistor is used for the crystal oscillator while an AS305 provides three times frequency multiplication. These are both low-cost NPN silicon transistors, manufactured locally by the A.W.V. company. While we did not actually try alternative types, transistor types BF115 and AY1119 would appear to be equally suitable.

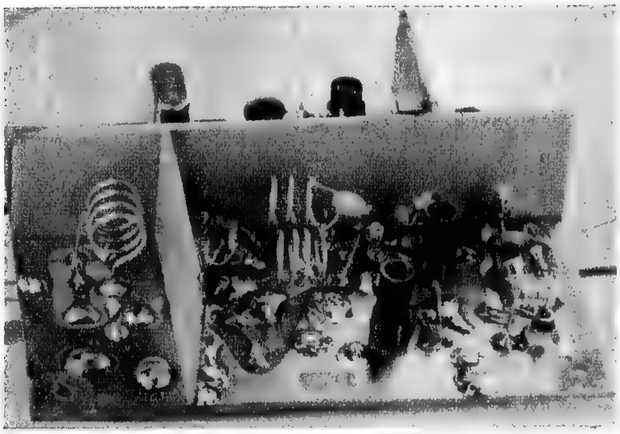
The oscillator/multiplier combination is operated from a zener regulated 9V supply voltage, ensuring stable oscillator operation and also ensuring that the injection voltages to the first and second mixers will be substantially constant over a range of power supply voltages. As the pass-band shape of the converter tends to be dependent upon the injection voltage levels, it is of the utmost importance to maintain these as near constant as possible.

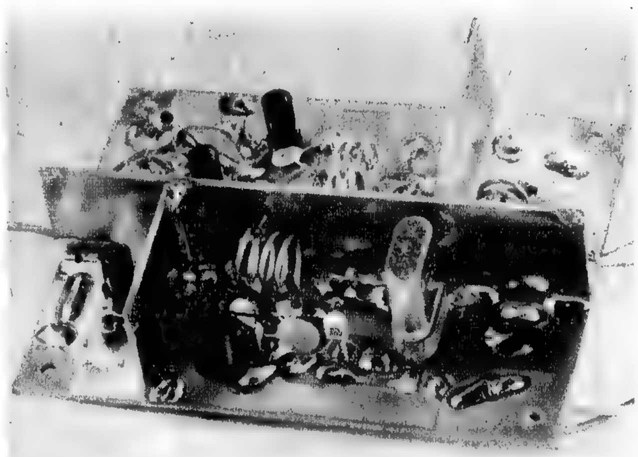
The zener regulator has been incorporated because some variation of supply voltage must be expected if the converter is operated from either "dry" cells of a 12V car accumulator. With dry cells there will be a gradual fall in supply voltage, and with an accumulator a voltage variation up and down between 14V and 11V would not be uncommon, these voltages corresponding to the "fully charged" and "almost discharged" conditions respectively.

Returning again to the circuit diagram, the RF amplifier may be seen to consist of one dual gate MOSFET with its second gate effectively grounded to signal voltages via a .001uF ceramic feedthrough capacitor. As already mentioned, the device operates as a cascode amplifier when connected in this way.

Signal from the aerial is coupled into a tuned circuit connected to gate-1 of the MOSFET. While it is necessary to tap the aerial well down L3 to avoid excessive damping of the tuned circuit due to low aerial source impedance, it is not necessary to tap down for the gate of the MOSFET, because of the high input impedance associated with both junction and MOS field effect transistors.

On the other hand, it is necessary to apply fixed and predictable "external" damping in the form of a 100K resistor connected from gate to ground so that the input tuned circuit will have sufficient band width. Similarly, other damping resistors have been used in





The two photographs above and at right show the underside of the wiring board, the former showing the signal circuitry while the latter view shows the oscillator multiplier. Note that these views are of the first prototype, which did not have copper around the mounting holes.

conjunction with tuned circuits connected to the gates of the remaining devices.

As a precautionary measure, the gate of the RF amplifier has been protected against excessive signal voltages by the inclusion of a pair of germanium diodes connected in inverse-parallel across the aerial input. Without the diodes quite high voltages could be developed across the input tuned circuit, due, for example, to radiation from nearby transmitters. Such voltages would normally destroy the gate insulation of the MOSFET.

A double-tuned band-pass transformer included in the drain circuit of the RF amplifier provides coupling into the gate 1 of the second MOSFET, which is the first mixer. Additional mutual coupling is provided in the double-tuned transformer by a 1pF capacitor.

The second gate for the mixer device is used for oscillator injection, being coupled to a tap in the tank circuit of the AS305 multiplier, via a 0.001uF capacitor. The second gate of a dual-gate MOSFET device provides an ideal point for oscillator injection, and used in this way the device makes an ideal mixing element.

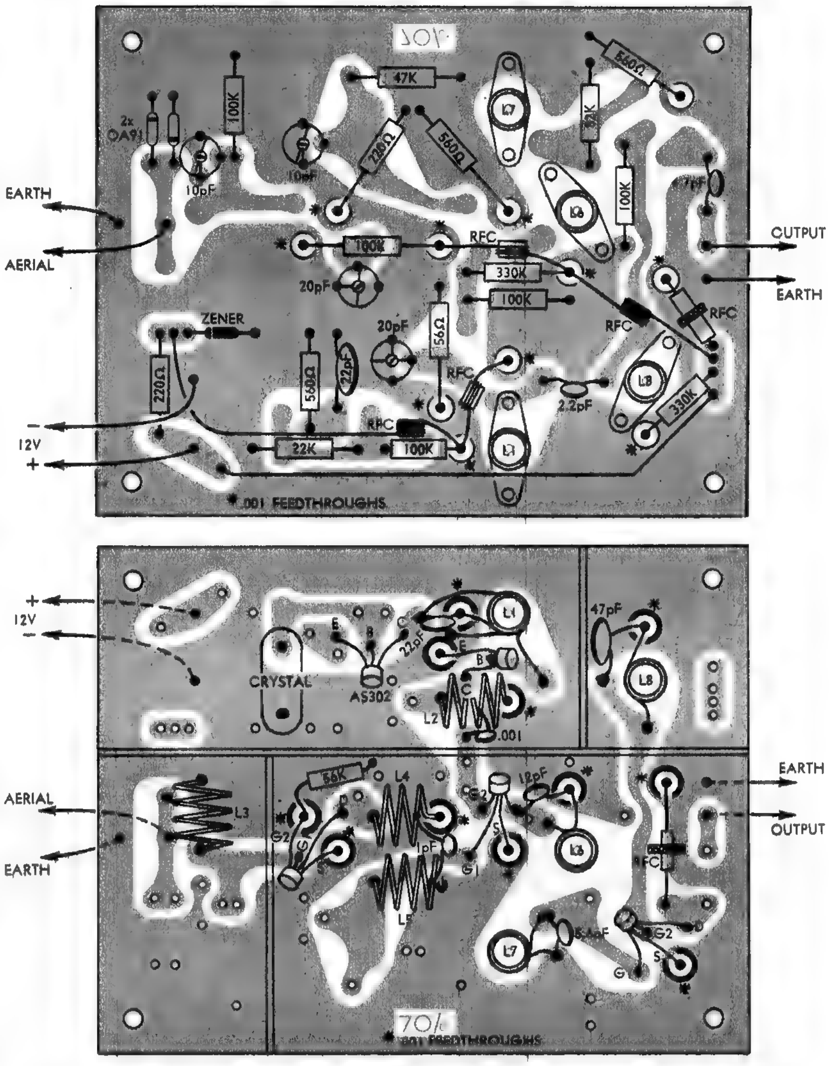
As suggested by the block diagram, there is a second doubletuned band-pass transformer in the main circuit of the mixer, and this is tuned to cover the first intermediate frequency range. L6 is adjusted for resonance at 38.625MHz, while L7 is adjusted for resonance at 40.625MHz.

In passing it should perhaps be noted that although the 144MHz amateur band is 4MHz wide, it is generally not necessary for a converter to provide optimum performance over this bandwidth. In most areas a major proportion of band activity takes place within the lower 2.2MHz, i.e., from 144 to 146.2MHz. Accordingly, it is currently only necessary for a converter to provide optimum performance over this section of the band, and this has been the approach adopted with our new design.

However, if desired, it is possible to adjust the tuning of the converter for a full 4MHz coverage, with a slight reduction in sensitivity. Alternatively the converter could bt simply tuned for a 2MHz bandwidth at the top end, if this were desired for some reason.

Again returning to the circuit diagram, it may be seen that a third dual gate MOSFET is used as the second mixer, heterodyning the first IF with the local oscillator frequency to produce the second IF output to be subsequently tuned by a receiver. It is worth noting that there is a parallel resonant circuit connected to the second "injection" gate of the last mixer. This is used to eliminate any second harmonic component from the local oscillator signal ensuring freedom from the spurious responses which would be produced by this component.

A simple untuned reactive load is used in the drain of the second mixer. Output coupling is provided by a 3.9pF capacitor from the drain. The particularly small value of capacitance is used to produce a broad series resonance at the second IF, ensuring maximum transfer to the low input impedance of the receiver aerial terminals. With most receivers the output voltage level to the aerial terminals should be more than adequate. It should be appreciated, however, that the voltage delivered to the receiver will tend to increase as the receiver input impedance increases.



The wiring diagram at the top shows component positions on the top of the wiring board, while the diagram below shows the components underneath the wiring board. Note the orientation of the coil former mounting flanges.

It may be noted that small RF chokes have been used to "decouple" the various stages of the converter, in order to ensure complete stability. These are hand wound on small ferrite beads, Mullard type FX1115, using 28 S.W.G. enamelled wire.

The converter is constructed entirely on a single sided printed wiring board, using readily available components. While there is copper on one side only, both sides are used to mount components. A good idea of component positions can be gained from the accompanying photographs of both top and underside.

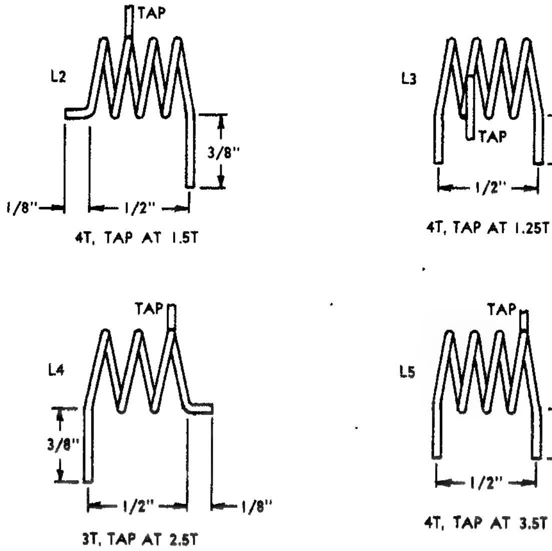
Connections from top to underside are either done directly by component pigtails in the normal way, or by means of Ducon .001uF ceramic feedthrough capacitors. The latter capacitors would in fact make a good place to start the construction; note that they are designed to mount one way, with the unplated portion of the ceramic barrel passing through the hole in the board laminate.

Next the coil formers should be glued in position using "Araldite" or similar adhesive. However, before gluing, ensure that there is not a small ring of copper remaining around the holes through which the formers pass. If there is such a ring of copper, it should be removed, otherwise it will behave as an effective shorted turn and considerably reduce the Q of the coil concerned. Looking at the wiring board artwork it will be seen that two concentric rings are used to indicate the positions of the holes for coil formers.

Having cemented the coil formers in position, the coils L1, L6, L7, and L8 should be wound using a 17/64in drill shank as a mandrel. After trimming to size, the coils can be slipped on to the formers (after allowing about 24 hours for the cement to cure), and slid down till the first turn is flush with the wiring board. This is shown in the photograph.

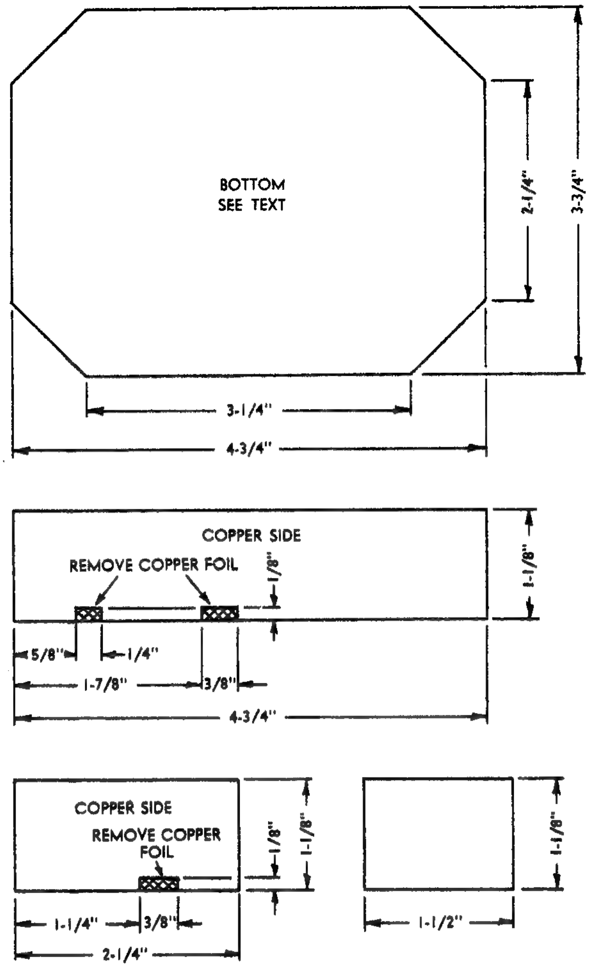
Looking at the copper side of the wiring board, the "bottoms" of the coil formers can be considered as being closest to the board, while their "tops" are furthest away. This being the case, the active or "hot" ends of all former mounted coils are those at the bottom of the formers.

In the case of L1, the larger primary



ALL AIR CORE COILS WOUND ON 3/8" MANDREL
FROM 18 SWG TINNED COPPER WIRE

L1 PRIMARY 10T 22 SWG ON 7mm FORMER
SECONDARY 2T 22 SWG
L6 10T 24 SWG ON 7mm FORMER
L7 12T 24 SWG ON 7mm FORMER
L8 6T 22 SWG ON 7mm FORMER



Diagrams giving the physical form and dimensions of the air-wound coils and the various shields are given above and at right. Constructors should follow the dimensions carefully.

winding is fitted on the former first of all with the secondary winding on top as indicated in the photograph. However, the same polarity arrangement still applies; the active end of the primary, which is connected to collector or oscillator transistor, is flush with the wiring board at the bottom of the former while the top end of the winding is connected to the supply feedthrough capacitor.

Similarly, the active end of the secondary winding, which is connected to the base of the multiplier transistor, is adjacent to the "cold" supply end of the primary while the earthed end of the secondary is at the very top of the former. The physical arrangements of the former mounted coils is shown in the circuit diagram, where the top of the coil symbol actually corresponds to the top of the former.

After completing the former mounted coils, the top side of the wiring board should be completed using the wiring diagram which has been included. The wiring of this side of the board is relatively straightforward, but care should be taken, nevertheless, to ensure that components are correctly placed. It should be noted that the Philips film-dielectric trimmers are colour coded according to value, yellow for 10pF and green for 20pF.

With the top side of the wiring board complete, including protection diodes and signal and power supply leads, the copper side wiring should be commenced using the wiring diagram for that side. This side should be wired to the extent involving the mounting of the self-supporting coils and taps, crystal holder, capacitors, RF choke, 56K resistor and the two transistors comprising the oscillator-multiplier chain.

The vertical shield sections made from single-sided copper laminate should now be soldered in position, commencing with the longest section. This section should be installed with the copper side toward the oscillator-multiplier section. The remaining two sections would be soldered in position with the copper side of the smallest toward the oscillator-multiplier section and the remaining section with the copper side facing away from L3.

At this stage the converter should be complete, with the exception of the all-important MOS field effect transistors. It is at this point that we must issue a warning regarding the handling of these devices.

Because of the extremely high input resistance and low capacitance provided by the insulated gates of a MOSFET device, even very small charges of static electricity can cause quite high voltages to be generated at the gates. If

144MHz CONVERTER PARTS LIST

1 Printed wiring board, 70/c1.
1 Metal box, see text.
2. Coaxial sockets.
1 Crystal socket and suitable crystal, see text.
4 Coil formers with slugs (7mm).
1 220uH RFC.
1 15uH RFC.
4 Ferrite beads, Mullard type FX1115 or similar.

TRANSISTORS

3 MOS field effect transistors, type 3N140, BFS28 or similar.
1 AS302 or similar silicon transistor.
1 AS305 or similar silicon transistor.

DIODES

1 BZY88/C9V1 diode.
2 OA91 germanium diodes.

RESISTORS (½-watt 5 p.c.)

2 330K, 5 x 100K, 1 x 82K, 1 x 56K, 1 x 47K, 1 x 22K, 3 x 560 ohms, 2 x 220 ohms, 1 x 56 ohms.

CAPACITORS

11 .001uF ceramic feedthrough.
1 .001uF ceramic.
1 47pF ceramic.
2 22pF ceramic.
2 20pF Philips miniature adjustable.
1 12pF ceramic.
2 10pF Philips miniature adjustable.
1 5.6pF ceramic.
1 3.9pF
1 2.2pF ceramic
1 1pF ceramic.

MISCELLANEOUS

18 SWG tinned copper wire.
22 SWG enamelled wire.
24 SWG enamelled wire.
Copper laminate board for shields, hook-up wire, solder, nuts and bolts, etc.

protective measures are not taken, these voltages can cause permanent damage of the gate-channel insulation of the device, rendering it entirely useless. For this reason MOSFETs are supplied by the manufacturer fitted with a device which shorts all of the electrodes together, preventing static charge build-up. It is essential for the protection of the device that the leads remain shorted together until AFTER the device is soldered into the circuit.

The shorting device takes different forms, depending upon the manufacturer of the MOSFET concerned. Devices manufactured by RCA have a spring circlip around the leads, and this may be left in place until the device has been soldered into circuit. It can then be removed by a gentle pull with a pair of tweezers or narrow-jaw pliers; **but whichever of these tools is used should be connected electrically to the earth conductor of the board during the operation.**

Mullard BFS28 devices have a "conducting rubber" ring around the leads, and this too can be left in place until after the device is soldered into circuit. It can then be cut away with a razor blade or similar sharp instrument, which should again be connected to the board earth during the operation.

Motorola devices are in contrast fitted with a small "Eyelet" through which the MOSFET leads are forced. Fairly obviously, it is not possible to remove this after the device is in circuit. Before installing such devices one must therefore wrap a fine piece of wire around the leads to allow the eyelet to be removed. The device can be then safely soldered in circuit and the wire subsequently removed, using earthed pliers.

As an additional precaution when soldering the devices into circuit, the tip of the soldering iron should be connected to the earth copper on the wiring board using a length of wire with alligator clips on each end. This will prevent damaging voltages and/or leakage currents from being produced by the soldering iron. (If for any reason soldering is required after the device shorting rings have been removed, it is very important that the iron tip be connected to the board earth.)

With the wiring finally completed by the addition of the MOSFETs, the converter can be connected to a 12V supply, **carefully observing the correct polarity**, and the circuit voltages may be measured. With the crystal out of the socket, thereby disabling the oscillator, there should be no voltage across the 56 ohm emitter resistor of the AS305.

The voltages across the source resistors of all three FETs should be measured to ensure that the devices are operating correctly. Readers may encounter slight differences from the voltages shown on the circuit diagram due to normal tolerances in the devices, but these may be ignored.

With the crystal in the socket, the bottom shield should be fitted by spot soldering it to the four outside corners and the two intersections of the three vertical shields. The bottom shield is thus held in six positions.

The completed converter can be fitted in a metal box at this stage, ensuring that it is grounded to the box at both input and output. Also, the converter should be mounted on conducting pillars so that the earth plane is grounded to the box at the four corners also.

Having installed the unit in a metal box, which may be of either diecast aluminium or steel, the alignment procedure may be commenced. First of all it is necessary to preset all the coil slugs and the tuning capacitors. The slugs can be "locked" using core locking compound or, more likely, elastic bands.

Set the slugs of all coils flush with the top of the wiring board, with the exception of the oscillator coil L1 — which should have the slug flush with the bottom of the former, near the secondary winding. Adjust L2's tuning capacitor for about half mesh and similarly adjust L4's capacitor for about one third mesh.

Set L3's capacitor for about one-eighth mesh and L5's capacitor for a little less. Now connect the converter to the supply voltage.

Using the lowest voltage range of a multimeter to monitor the voltage across the 56-ohm emitter resistor of the AS305, adjust the oscillator slug (L1) for a peak. Now adjust L2's tuning capacitor for a peak of about 0.6V across the same resistor.

Using the three-volt range of the multimeter to monitor the voltage across the source resistor (560 ohms) of the second mixer, wind the slug of L8 into the coil until the voltage dips to a minimum. Using the same meter range to monitor the voltage across the source resistor (560 ohms) of the first mixer, readjust L2's tuning capacitor for a dip to minimum voltage. Now readjust the oscillator slug for a voltage peak across the 56-ohm resistor and at this stage correct injection to the mixers is obtained.

The rest of the alignment procedure consists of adjusting the various signal-tuned circuits for correct frequency response. For this part of the alignment it is necessary to connect the converter to a receiver of appropriate frequency coverage and it is desirable, also, to have access to a VHF signal generator. In the absence of a generator, off-air signals can be used.

If a generator is available, set it to 145MHz and adjust the capacitors tuning L3, L4 and L5 for maximum output. Maximum output can be determined using the "S-meter" of the receiver, or alternatively, by monitoring the speaker output with the signal generator set to a sufficiently low level so that the peak will not be disguised by the AGC action of hte receiver.

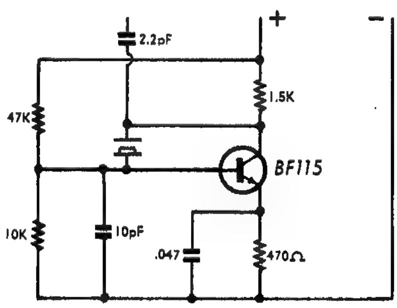
If a generator is not available, the signal circuits can be adjusted to peak on the sound carrier of TV channel 5A at approximately 143.75MHz. If channel 5A is not available then any other off-air signal will suffice.

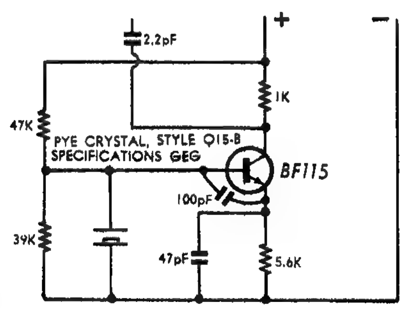
The final part of the alignment consists of adjusting I6 and L7. L6 is adjusted for a peak at 146MHz while L7 is adjusted for a peak at 144MHz. Again these adjustments should be made using a signal generator but otherwise off-air signals can be again used. L6 can be adjusted using signals on the 146MHz "net" frequency while L7 can be adjusted again using channel 5A or some other signal near the bottom of the band.

While the converter can be aligned quite successfully using spot frequencies as just described, it is really preferable to use "sweep alignment" techniques. If the necessary equipment is available this can be done quite readily. We hope to publish an article describing such alignment techniques in a future issue.

The performance of the converter should be more than acceptable when aligned as described. We would point out that some care is necessary when making the various adjustments particularly with regard to the injection voltage levels. But, provided that care is exercised, readers should have no difficulty in reproducing a unit with similar performance to the prototype. ■

ALTERNATIVE OSCILLATOR CIRCUIT





Following publication of the article on the 27MHz Radio Control Receiver: (February, 1970) a spokesman for Pye Crystal Products Division has made a number of suggestions specifically relating to the type of crystal specified for the receiver and the oscillator configuration. An alternative configuration which the Division prefers is shown, together with the original, in the accompanying diagram. The style of crystal to be used is Q15-B with the specification code GEG.

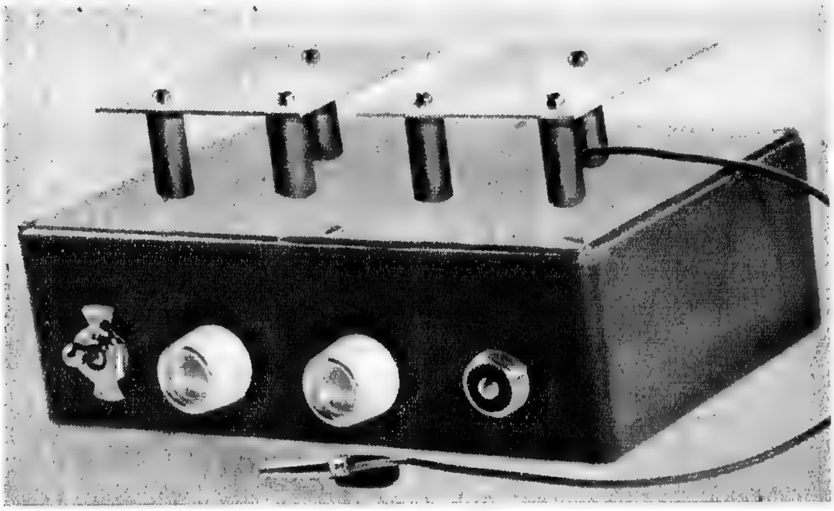
The alternative configuration can be accommodated on the existing wiring board with little difficulty by simply altering component values and by the addition of a 100pF capacitor on the rear of the board connected between base and emitter of the oscillator transistor. The resistor values should be changed to those shown, while the 10pF capacitors is replaced by the crystal and the .047uF capacitor is replaced by 47pF.

With the new oscillator configuration performance of the receiver remains substantially unchanged but we suggest that intending constructors follow the recommendations made by the crystal manufacturer. ■

ELECTRONIC BONGOS

Unit can be fed into any amplifier

by Leo Simpson



The prototype Electronic Bongos shown housed in a diecast box and with aluminium touch plates mounted on insulating pillars. Other, more novel methods of presentation could be used.

Over the past few years there has been great interest in electronic musical instruments, ranging from mere toys to large and expensive recital units. In this article we describe a device which can simulate bongos. The circuit can, in fact, be adapted to simulate other percussion instruments.

The electronic organ has undoubtedly held pride of place as the best known electronic instrument, although there have been electronic pianos and other instruments like the "Theremin," which involve a sound and technique all their own. (See "Electronics Australia," June 1969, "A Solid-State Theremin").

During the past few years, devices have appeared which simulate the sound of the common percussion instruments and which can automatically reproduce a wide variety of dance rhythms. The earliest example were perched alongside organs and pianos within easy each of the player. More recent units, vastly reduced in size by solid-state circuitry, are being built right into the basic instrument.

With the advent of musical combos in which all the instruments are electronically amplified, interest in "synthetic" percussion sources has received a further boost. In this article we introduce one of the circuits used for simulating percussion instruments.

A percussion instrument may broadly be defined as one which is played by being struck, whether it be by hand or with drumsticks and such like. While this definition would seemingly include pianos and other such instruments, the definition has been limited by usage to the more elementary type of instrument.

Physical objects which are struck forcibly tend to vibrate in a resonant manner. The frequency, waveform, amplitude and duration of the vibration (or vibrations) will depend on the shape and the nature of the material.

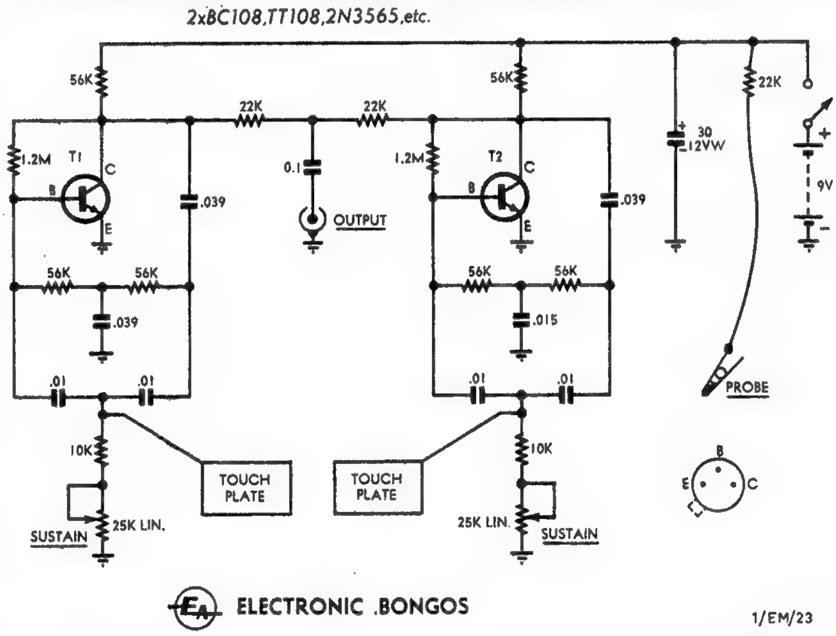
If the object is a tuning fork it will vibrate at virtually a single frequency and the waveform will closely approximate that of a sinusoid (i.e., sine or cosine function). The vibration will be sustained for a relatively long time.

In the case of a bronze bell, the vibration will be more complex, in that it is made up of a fundamental frequency and a number of other frequencies which one would hope to be musically related to the fundamental. The bell's vibration will be large in amplitude and will also continue for some time.

On the other hand if the object being struck was a large block of concrete, the vibration would be small (relative to the force of the blow) and of very short duration. Its vibration would be muffled or "damped" by the nature of the material. For all practical purposes we could say that the tuning fork and bell are resonant bodies, while the concrete block is non-resonant.

To be musically significant, percussion instruments need to be resonant bodies whether they be bells, blocks or the stretched skin of a kettledrum.

In setting out to synthesize a percussion instrument, the starting point is an electronic analogy: A circuit which resonates when an electrical impulse is applied to it, the electrical impulse being analogous to a physical blow. A necessary adjunct is a means of deter-



The circuit diagram of the Electronic Bongos. Two Twin-T oscillators are used. The name "Twin-T" arises from the configuration of the two RC phase-shift networks associated with each oscillator.

MACRON ELECTRONICS PTY. LTD.

RECOMMENDS foster

SPEAKER ENCLOSURES

SPEAKERS

2-WAY AIR-SUSPENSION SYSTEMS

MODEL No.	IMPEDANCE [Ω]	FREQ. RANGE [c/s]	INPUT [W]	SPEAKERS [mm]	DIMENSIONS [mm]
FCS-104	8	95~20,000	8	100(W), 85(T)	250H×158W×173D
FCS-200	8	60~20,000	40	200(W), 50(T)	530H×294W×240D
FCS-207	8	45~20,000	30	200(W), 50(T)	540H×295W×220D
FCS-208	8	70~20,000	30	200(W), 50(T)	480H×280W×200D
FCS-250	8	50~20,000	30	250(W), 80(T)	597H×321W×300D

COMPACT SPEAKER SYSTEMS

MODEL No.	IMPEDANCE [Ω]	FREQ. RANGE [c/s]	INPUT [W]	SPEAKER [mm]	DIMENSIONS [mm]
BF-103S	8	110~18,000	8	100(FULL-RANG)	320H×200W×174D
BF-163S	8	60~16,000	10	160(FULL-RANG)	384H×240W×174D
BF-203S	8	45~16,000	15	200(FULL-RANG)	477H×298W×254D

FULL-RANGE SPEAKERS

DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
100	4	**FE-103**	8/16	65~ 95	f_0~18,000	96	10
160	6½	**FE-163**	8/16	40~ 60	f_0~20,000	98	10
200	8	**FE-203**	8/16	35~ 55	f_0~16,000	100	15
200	8	**FE-201**	8/16	60~ 90	f_0~16,000	100	8

WOOFERS

DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
160	6½	**FW-162**	8/16	40~60	f_0~3,000	95	30
200	8	**FW-202**	8/16	25~35	f_0~2,000	97	45

W.A. D. K. Northover, 1 Dunvegan Road, Applecross, 6153.
TAS.: Nichols Radio, 91 Wellington Street, Launceston, 7250.

N.S.W.: Jacoby Mitchell, 469-475 Kent Street, Sydney, 2000.
VIC.: Macron Electronics, 70 Batesford Road, Chadstone, 3148.

S.A.: Neil Muller, 8 Arthur Street, Unley, 5061.
QLD.: T. H. Martin, 56 Edward Street, Brisbane, 4000.

Homecrafts TAS., Astor House, 199 Collins Street, Hobart, Tas., 7000

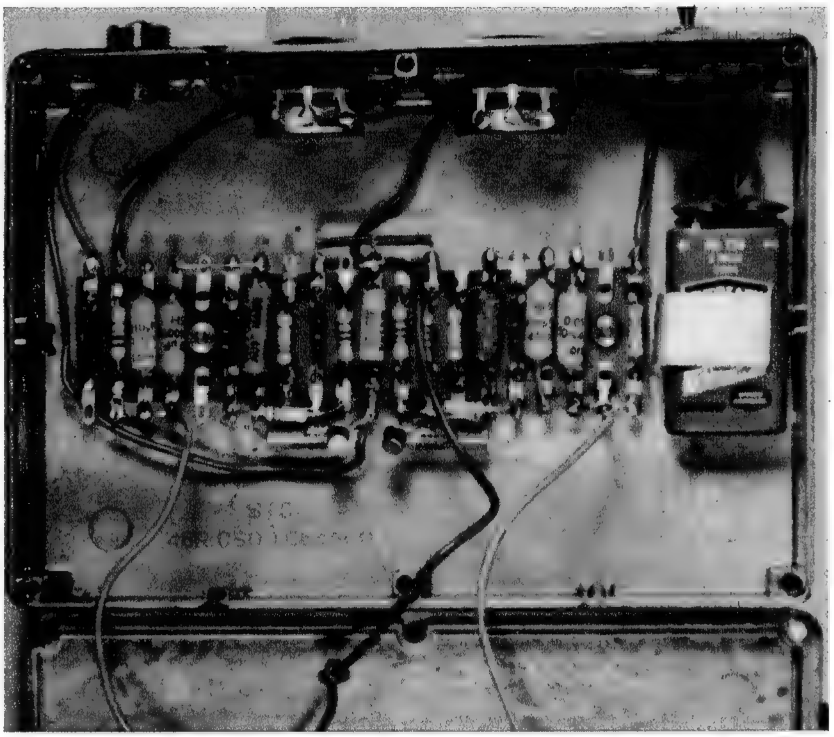
mining the frequency and the damping of the resonance, so that we can alter the "quality" of the sound, as reproduced, so that it will simulate that from the acoustic instrument.

Referring now to the circuit diagram, the basic configuration we have suggested is a Twin-T or Parallel-T oscillator. The name arises from the configuration of the two RC phase-shift networks associated with each oscillator. While we have used the Twin-T configuration here to achieve a particular result, it has a wide range of possible applications in electronic musical instruments.

As the resistance of the 25K potentiometer in one of the T-networks approaches its minimum resistance setting, the circuit will begin to oscillate continuously. The output wave form taken from the collector will be substantially sinusoidal and the frequency can be set anywhere in the audio range by selection of the other components in the T-networks. While it could be used as a continuous tone source, other modes of operation are possible.

For example, if the DC supply rail is connected via a decoupling network consisting of a suitable resistor and capacitor, the circuit can be arranged to have a "sustain" feature. When the supply is connected (by an organ key for example) the capacitor would rapidly charge to the supply potential and allow the oscillator to start. When the supply connection is broken, the charge stored in the capacitor would allow the oscillator to continue operating with a gradual decrease in amplitude, giving a "sustain" effect. The frequency changes only very slightly with decreasing voltage.

As we have already indicated, increasing the resistance of the 25K potentiometer will cause the amplitude to decrease to the point where the oscillator stops altogether. At this point, the oscillator is said to be quiescent. An electrical impulse applied to the junction of either of the T-networks or to the base of the transistor will shock the circuit into brief oscillation and the degree which the oscillation is sustained will depend on the setting of the potentiometer. If it is set for maximum resistance, the oscillation will be very short — only a few cycles. If the potentiometer is set so that the oscillator is just into the quiescent region (i.e., just on the point of continuous oscillation) the oscillation will probably last for twenty or more cycles. Obviously enough, the potentiometer can be used to vary the damping of the oscilator.



A view of the layout inside the case. Since there is space to spare inside the case, more than two oscillators could be used, if the constructor desires.

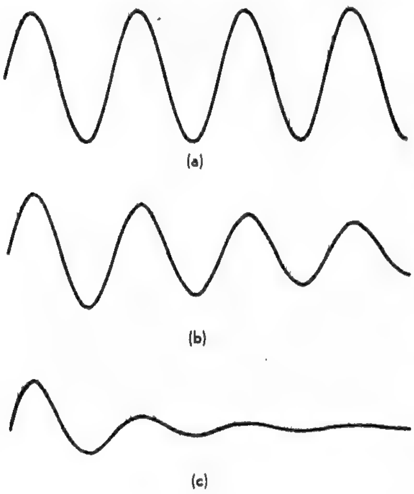


Figure 1

The above waveforms show the three modes of oscillation possible with a Twin-T oscillator. (a) is continuous; (b) is lightly damped and (c) is heavily damped.

Figure 1 shows the modes of oscillation possible. 1 (a) shows a continuous oscillation at constant amplitude. 1 (b) shows a lightly damped oscillation and 1 (c) shows a heavily damped oscillation. Note that the waveform remains essentially sinusoidal.

To synthesize Bongos then, as we have in the particular instrument featured, we have used two Twin-T oscillators in the ringing mode. Other percussion instruments can be similarly simulated by changing the values of the capacitors in the T-networks. For example, a bass drum can be simulated by using larger capacitors to lower the fundamental frequency of oscillation. Bass drums being what they are, of course, only one oscillator would normally be involved.

For a bongo set, two Twin-T oscillators are needed. One is tuned to around 280Hz and the other to around 400Hz. Of course, constructors may build units with more than two oscillators, if they so desire. Tuning is simply a matter of selecting the capacitors in the T-networks.

The electrical impulse to shock the oscillators into the "ringing" mode is obtained by touching the "touch plates" connected to the junction of the T-networks containing the potentiometers. In some cases, the "stray" hum field will be strong enough for the oscillators to be triggered when the plates are touched. (i.e., the hand is used to momentarily inject hum into the circuit). In other cases, there may be no mains wiring in the vicinity and so we provided a lead connected to the positive supply rail, via a 22K resistor.

PARTS LIST

PARTS LIST:

1 diecast box and lid. Approximate dimensions 6¾ x 4¾ x 2¼ inches.
1 battery (Eveready 216 or equivalent) and plug to suit.
1 20-lug tagstrip.
1 SPST toggle switch.
2 25K (lin.) potentiometers.
1 output socket.
2 BC108, TT108, 2N3565 or similar silicon NPN transistors.

CAPACITORS

(Voltage ratings higher than 9V will suffice.)

1 x 30uF/12VW electrolytic.
1. x 0.1uF, 3 x .039uF, 1 x .015uF, 4 x .01uF, all ceramic or polyester.

RESISTORS

(½ or ¼ watt rating)

2 x 1.2M. 6 x 56K, 3 x 22K, 2 x 10K.

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2 knobs, 6 insulating pillars, aluminium for touch plates, screws, nuts, battery clamp, hook-up wire, alligator clip, solder, etc.

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SPECIFICATIONS

Power amplifier section
Power output: Dynamic power output, 58 watts both channels (5% harmonic distortion, constant-supply method). Rated output, 15 watts per channel, both channels operating.
Harmonic distortion: Less than 0.5% at rated output (at 1 kHz).
Intermodulation distortion (60 Hz: 7 kHz = 4:1): Less than 1% at rated output.
Preamplifier section
Frequency response: TUNER, AUX-1, AUX-2, TAPE; 20-60,000 Hz; +0 dB; —3 dB; PHONO-1, PHONO-2; RIAA equalization curve ±1 dB.
Tone controls: BASS 100 Hz ±10 dB; TREBLE 10 kHz ±10 dB.
Filter: HIGH FILTER 6 dB/oct. above 5 kHz.
Loudness control: 100 Hz + 8 dB, 10 kHz + 4 dB (Att. —30 dB).
S/N ratio: PHONO-1, PHONO-2, better than 70 dB, 3 mV TUNER, AUX-1, AUX-2, TAPE, REC/PB; better than 90 dB, 250 mV.
Circuit: 20 transistors, 5 diodes.
Dimensions: 16 5/16"(W) x 4 7/8"(H) x 9 11/16"(D).
Weight: 10 lbs.

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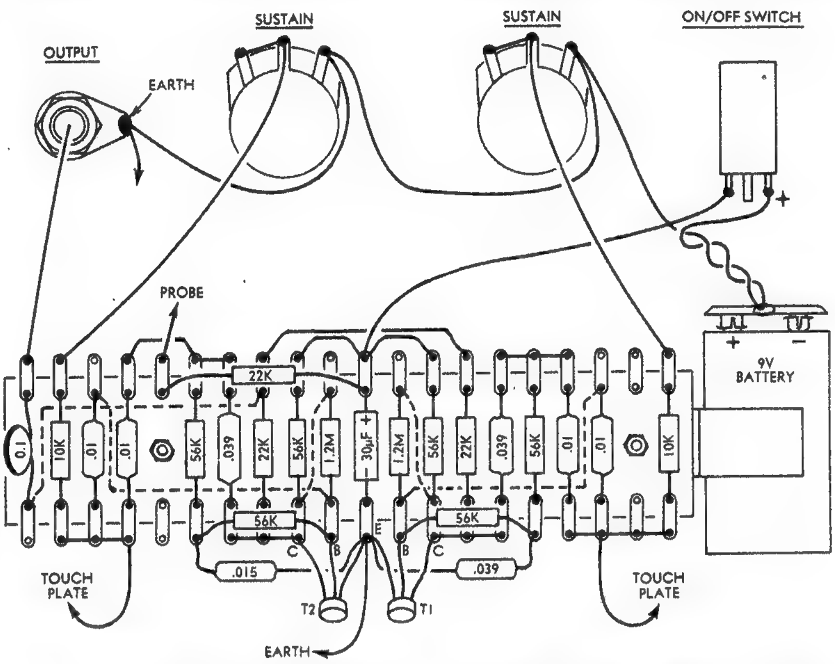
DIAGRAM SHOWS COMPONENTS AND WIRING



The assembly of the Bongos is a straight-forward process if this wiring diagram is followed closely.

This is held in one hand or connected to the player's metallic watch band, if this proves more convenient. In this way, a DC pulse is injected into the circuit via the 22K resistor and the player's skin resistance, when the respective plates are touched. The 22K resistor prevents the battery from being discharged rapidly if the lead is inadvertently shorted to the case with the unit switched on. The 22K resistor is not shown in the photograph of the prototype, as it was inserted after the photographs were taken.

Perhaps, in passing, we should point out that there are several other applications in electronic musical instruments where this circuit can be used to advantage. One of the most notable is that of active filter, which can be used for waveshaping in electronic organs. Most of the tone generators in electronic organs produce square waves but, to produce flute or tibia voices, the square wave must be filtered to almost a pure sine wave. This would be difficult with passive filtering but the active filter can be fed with any waveform (into the base of the transistor) and will produce fairly clean sinusoidal wave forms near its resonant frequency.

While we have specified the use of high-gain NPN silicon transistors there is no reason why high-gain PNP silicon transistors cannot be substituted if they are on hand. The only modification required to the circuit is to reverse the polarity of the supply voltage and the electrolytic capacitor.

Note that the prospective constructor is not limited to the method of construction that we have used. For example, a unit could be built up featuring miniature bongo drums made out of wooden egg-cups; the touch plates would be the "skins" of the bongos. The method we have used is described in the following paragraphs.

A diecast box measuring 6¾ x 4¾ x 1/8 inches is used to house the components. This is large enough, if need be, to house more than two oscillators. All of the components, with the exception of the two potentiometers, are mounted on a 20-lug section of tagstrip. While layout is not critical, we would advise novice constructors to follow that shown in the wiring diagram and photograph.

When drilling the diecast box, use a sharp drill at high speed and a low rate of "feed" (i.e., do not put too much pressure on the drill). Preferably, use a drill stand. If care is not taken when drilling, the box may crack.

The touch plates we used were made of light-gauge aluminium and measured 3 x 2¼ inches. They were mounted using three 1-inch insulating pillars per plate. Each plate is connected into circuit via lead which is soldered to a lug under one of the plate-securing screws, underneath the plate.

While we have used roundhead screws to secure the touchplates in the prototype, constructors may wish to use countersunk screws to lessen the possibility of snagged fingers when the unit is played exuberantly.

The lead connected to the supply was brought out through a hole in the case lid. As shown in the photograph on page 79 the lead is fitted with an alligator clip, to be connected to the player's watch band. However, this may prove awkward in practice and it may be more convenient to solder the lead to a hand-grip made of tinplate or other metal.

The battery is a small nine-volt type, Eveready 216 or equivalent. Since the current drain is considerably less than 1 milliamp the battery life should be long—almost equal to the shelf life.

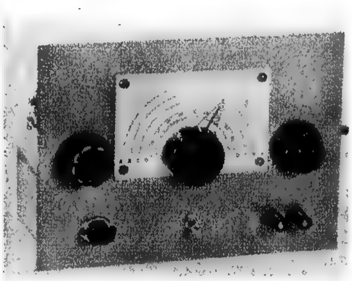
The Electronic Bongos can be used with just about any amplifier, provided they do not overload the amplifier input. The more powerful the amplifier, the better; the same can be said about the size of the loudspeaker. For best results, it should be used with a high power guitar amplifier and matching loudspeaker system. The output signal from the Electronic Bongos is approximately 0.5 volts RMS which is enough to drive almost any amplifier to full power using the "pickup" or "auxiliary" input.

When assembly is completed, connect the Bongos to an amplifier and loudspeaker. Switch on and turn both potentiometers fully clockwise. Both oscillators should be operating. If not, turn off and check for mistakes in wiring. Now set each potentiometer so that its associated oscillator is just "on the verge" of oscillation. Hold the probe in one hand and tap each of the touch plates with a finger. Each oscillator will emit a sharp "bong" when the appropriate touch plate is touched. It is surprising how similar it is to play to a conventional set of Bongos.

Go ahead and build the Electronic Bongos. In a following issue we hope to publish another economical circuit, that of the "Autodrum." This can be keyed manually (or with your feet!) or will continue beating automatically, at any rate desired.

NEXT MONTH

SOLID STATE FREMODYNE



Due to the remarkable popularity of the two earlier valve type Fremodyne receivers, we have produced a solid state version. The new Fremodyne covers from 30MHz to about 190MHz. Circuit-wise and mechanically, readers will find it somewhat more straightforward. It is built on the same size chassis and panel as previously.

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FORUM

Relativity — always good for an argument!

A sure way to start an argument is to begin talking about such things as relativity, time dilation, the fourth dimension, and so on. As a stimulant to strife, it is equally effective in the laboratory, over morning coffee — or in the columns of a journal such as "Electronics Australia."

Conducted by the Editor

Many years ago, as an outcome of just this sort of argument, our science writer of the day, Calvin Walters, wrote a couple of articles around these subjects. The articles prompted a seemingly never-ending stream of correspondence, ranging from learned letters to one brief but touching comment along the lines: "Having read Calvin Walters' articles, I can only say that, if he is sane, then I am mad; or vice versa."

In the face of that experience, we made a vow on a stack of physics text books that we would steer clear, in future, of relativity and its implications. But, recently, Mr Debnam came to light with his unsolicited contribution on the general subject. We were faced with the alternatives of using the article or sending it back with that dismal and time-honoured covering note beginning: "The Editor regrets . . ."

Well, we weakened and published the article in the January issue; now we have to face up to the ensuing comments and the correspondence. This has varied from appreciation for an in- te fr ir f

pressing highly mathematical and even abstract concepts in ordinary prose, and (2) through that prose, building neat mental images very close to the fringe of our comprehension.

To most people, most of the time, physical properties are obvious, discernible, measurable and rigid and, while some might accept the notion that they could be modified by relativistic factors, we never quite come up with a mental picture to match the notion. Similarly, while we may accept the idea of time dilation, we find the greatest difficulty in relating it to that inflexible, inexorable thing we know as time, from every practical circumstance of life.

To be sure, individual groups of scientists, pursuing specialised research, do encounter specific implications of relativity, in circumstances which, overall, have seemed to validate the predictions of Einstein. Particles appear to behave as if their parameters were subject to modification; as if time, for them, was dilated. Quite recently, time dilation came up for consideration in the exercise of flying an atomic clock ... inter-relate nation-

what another group ridicules as preposterous error. Science fiction writers add to the confusion by stretching notions and concepts to fit their own plots, so that the likely is discredited by seeming to consort with the unlikely.

Having said this, however, it would be foolish to adopt an attitude of complete mental defeatism. If it is not possible to build a whole new set of mental images incorporating relativism, it certainly is possible to absorb mentally some of the factors which make traditional concepts less rigid than one might otherwise consider them to be.

Take, for example, the seemingly elementary matter of determining whether or not certain events did happen or will happen simultaneously.

At an athletic meeting, the timekeeper at the finish tape should presumably click the stopwatch at the precise instant that the sound of the starting gun reached the ears of the runners. It is a well-known fact that the timekeeper should react to the flash from the distant barrel, not the sound of the explosion, because the relatively slow-moving sound impulse would put the timekeepers "now" a fraction of a second behind the starter's "now."

Because of the finite speed of light, there must be some delay even in the visual signal but the discrepancy is negligible, having in mind the distance involved and the degree of precision required.

But one does not need to go beyond our ordinary terrestrial environment to find examples where the finite speed of light (or radio waves) makes it difficult to establish the coincidence of certain events. Scientists can no longer rely entirely on radio signals to compare time standards around the world because of the finite and variable propagation time ... signals. To be a little less ex-

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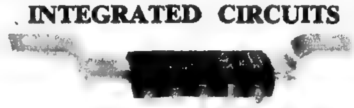

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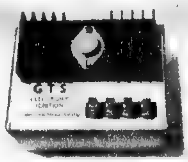

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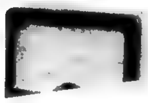

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MAGNETIC CARTRIDGES

At 66.

"happen" until after the turn of the century!

It becomes abundantly evident that "now" has a purely local, even subjective connotation; that the coincidence of events must be rendered ambiguous by the time it takes to exchange information between the respective reference points.

It can be argued that an observer equidistant from the two happenings would be able to verify their coincidence. Perhaps so, but he would still face the difficulty of relating the "now" at the respective events with the "now" of his observation site.

When studying the night sky, someone could conceivably observe that the star you are looking at might have blown up long ago. That you are gazing at something that might no longer exist. Commonplace as such statements are, they are not necessarily valid. One can logically question whether time can be so casually cross-referenced in space, without considering the likelihood that no information, influence or interaction can propagate faster than the speed of light.

We are still talking about the subjective quality of "now" and the kind of problem that attends the timing of a footrace. All that has happened is that the problems have been scaled up to the point where they are as obviously philosophical as they are technical.

Perhaps we can drop in a couple of small quotes from the latest Boeing magazine, from Boeing consultant Dr. Zdenek Kopal:

"A 120 inch optical telescope in earth orbit would increase man's astronomical vision 10 times to about 20 thousand million light years . . . man will see objects as they existed at the dawn of time."

One could go on, as did one of the correspondents, and talk about Doppler effect on time between rapidly receding bodies; how, if it were possible for each to observe the other's clocks, they would seem to be ticking very slowly.

But we are in danger of doing the very thing we set out not to do; of diverting a lot of space to an interesting but fringe subject.

The purpose of the article will have been served if we have succeeded in making the point intended: That one can readily enough generate a mental resilience in respect to some things affected by relativity, even if a full-scale mental image of the relativistic situation evades one.

And with that I change the subject!

RELATIVITY: TYPICAL COMMENTS

SIZE: Suppose we were to decide that the universe would be more manageable if reduced in size by a factor of 10, and suppose we had power to achieve this. Most of us would be apprehensive as the day for conversion arrived but, after the event, we would find that things looked no different than before.

THAT CAR: There is a problem only for people with insufficient "nous" to see that, if the car is being driven at that speed, it could not simultaneously be stationary, allowing the garage door to be shut! Also, anybody driving at the speed would know that measurements taken under those conditions could not be used as a basis for stationary accommodation.

TIME: I cannot accept that real time is altered by velocity; if it is then the very basis of Einstein's special theory of relativity falls to pieces. The time dilation is only proven by an argument with a false step in logic.

TIME REFERENCE: A mistake perpetrated by professors and textbooks alike is the "Area of Uncertainty," which is defined as a region in time in which events separated by large distances cannot be said with certainty to have happened simultaneously. I maintain that, in retrospect, any two events can be assessed as to whether or not they happened simultaneously.

TIME DILATION: The true situation is represented by a simple extension of the Doppler principle. If it were possible for an observer on earth to see a clock on a space ship moving away at near the speed of light, the clock would appear to be clicking very slowly. On the return journey, it would appear to be ticking very fast. On return to earth the total discrepancy would be zero.

MOTION IS RELATIVE: Why cannot the usual argument be reversed: The earth recedes from and returns to the spaceship at near-light speed? So twenty years passes on the spaceship; two months on earth. Who gets "observer priority?"

ACCELERATION: The whole "twin paradox" (Jan. page 13) is based on the invalid assumption that the effects of acceleration, which Twin A must necessarily experience, can be made negligible by spreading them over a sufficiently large distance. The wider, General Theory of Relativity resolves the argument by taking acceleration fully into account. The paradox never really existed except in the minds of early critics of the theory.

PARTICLES: Your writer observes that mesons with a normal life span of approx. 0.2 nanoseconds have been observed to travel distances of about 10KM when their velocity approaches c. How is the path measured and have other reasons been sought for the apparently longer life span? I do not accept that "evidence . . . is abundant" that time passes more slowly on a fast moving object.

From the Author

- The motor car paradox is the kind of thing commonly introduced to provoke discussion. For the car to be contained in the garage, it would have to stop, negating the relativistic effect.
- Dr Einstein has pointed out that no observer has "observer priority." Each would form his own assessment of the passage of time.
- The General Theory of Relativity is concerned with gravitation and accelerating forces, which Einstein showed to have equivalent effects — the Principle of Equivalence. For an observer to make a return journey to a distant star system, he would have to be subject to at least four major accelerations, with consequent large time-dilation factors.
- Measurements of the time dilation effect was first made by Ives and Stilwell in 1938, involving the spectral emission of hydrogen atoms accelerated to 0.006c. After correction for Doppler effect, a difference remained which matched the time-dilation prediction. Similar measurements since have involved spectral emissions from the Sun and the separate effects are known as "Doppler Shift" and "Einstein Shift."
- In the Brookhaven National Laboratories particles are accelerated in the Cosmotron Particle Accelerator. By counting the number of times a particle or particles group passes a certain point, speed, distance and lifetime can readily be related.
- On page 11 of the original article, the energy obtainable from one gram of matter was expressed as "90 million joules." This should have read "90 million million joules," an expression intended to avoid confusion between the British billion and American billion.

Radiation hazard

An article about television receivers by Phillip Adams in "The Australian" newspaper seems to have disturbed a number of people. He begins: "As if the programs weren't bad enough, it now seems that our sets may be killing us."

He goes on to tell how John Ash Nott, an American scientist, placed two cages of rats in front of a black-and-white television screen, the sound being turned off and the screens being shrouded with black paper to hide the picture. Allegedly, the rats were abnormally active at first, then became lethargic; so much so that after a month, they had to be prodded into activity. Subsequent autopsies indicated severe brain tissue damage.

The report indicated that, with a colour television receiver, the effects were more serious again. Rats placed in front of the screen died within 12 days. When placed as far as 15 feet from the screen, breeding patterns were seriously disturbed. It continues:

"In testing one colour set, an experimenter held his hand eight inches under the tube for 15 minutes and found that, at the end of the time, his hand carried enough radiation to take an X-ray.

"Some 90,000 TV sets have been withdrawn by one U.S. manufacturer in recent weeks. Unconfirmed reports claim that they were emitting as much as 600 times the amount of radiation considered safe for human exposure."

Adams says: "I checked Nott's findings with the president of the Columbia College in Los Angeles, an institution which specialises in training TV technicians. He said cheerily that anyone who sat within 10 feet of a television set was off his head."

One paragraph in Adams' story has a rather familiar ring:

"Another disturbing feature of the Nott researches is that a congressional probe conducted by one Paul G. Rogers was given no publicity at all by the major news media in the U.S.A. The underground Press in America, which is championing Nott's cause, claims a conspiracy of silence between the networks and the manufacturers — deliberate collusion in suppressing highly controversial information."

For the clipping of Adams' report we are indebted to J.C., of Harbord,

N.S.W., who invites us to comment. Another reader, from Turramurra, N.S.W., asks:

"Does this mean that every operator of a CRT computer terminal is likewise in danger? What about servicemen? Should I surround my TV set with a lead screen, reverse the leads to the yoke and view the screen through a 45-degree mirror? If there is anything in this, why haven't we heard of ill effects on viewers caused by radiation? In Australia alone, television has been widespread for over 10 years, yet there has been little if any mention of mutations in children born to television-watching parents."

What do we think about it all?

First and foremost, one has to be careful about criticising someone on the basis of a report. At the same time, it seems fairly obvious that John Ash Nott is claiming that tests performed with rats in the vicinity of both monochrome and colour television receivers have revealed radiation at a highly lethal level.

Any such findings would be completely at variance with the overwhelming majority of those who have investigated this subject, using equipment specifically designed to detect and monitor radiation in situations where it could be a problem. They have given black-and-white receivers, as a class, a clean bill of health. Apart from actual readings, they point out that the accelerating potentials involved are not high enough to produce significant radiation, anyway.

For this, we do not need simply to accept the overseas verdict. Tests by Government health authorities in Australia have completely supported the finding, the radiation from typical Australian receivers being either completely indetectable or barely detectable so close to the "works" of the bare chassis that the investigators were far more worried by the risk of shock than the risk of irradiation. Significantly, the tests had to be done on the bare chassis, because radiation was quite undetectable under living room conditions with the receivers in a cabinet.

What then affected John Nott's rats, caged in front of such a set? It's difficult to avoid the conclusion that their demise was the result of some other quite non-electronic catastrophe. What supports this further is the clinically established fact that radiation kills, not primarily by affecting the brain, but by affecting the blood structure. Exposed to the kind of radiation which kills within, say, a month, victims do not exhibit disorientation or accelerated brain damage.

Therefore, in terms of radiation, the demise of the rats was not only highly unlikely, but also highly uncharacteristic.

The most likely explanation for Nott's results was supplied by Philip Watson, our Assistant Editor. Phil pointed out that there is some acoustic output from television receivers at the line-scan frequency — in this case 15,750Hz. Manufacturers take precautions to limit the amplitude of the sound so that it will not trouble viewers. With a frequency above 15KHz, however, it is not too much of a problem because the sensitivity of human ears tapers off in this region. But this would almost certainly not be true for the rats which were imprisoned, not just in an environment of suspected radiation, but most likely in an environment involving (for them) a continuous nerve-shattering whistle. For the colour set it may well have been more intense than for the monochrome set. There is no suggestion that Nott even thought of this!

There is common agreement that colour television receivers are more prone to radiation than monochrome receivers because the accelerating potentials are somewhat higher.

Knowledge of this fact has caused a certain amoung of apprehension, particularly in the U.S.A. Fears were greatly maginified by the discovery and disclosure, a couple of years back, that certain receivers and certain circuit elements did produce discernible radiation in the immediate environment of the chassis. Corrective measures were taken — and this brings us to a further point.

As far as the electronics industry was concerned, there was no conspiracy of silence. Magazines around the world mentioned the brand and the models concerned, discussion of the cause of such radiation, its extent and direction; the corrective measures which were applied to the receivers recalled, measures to avoid the trouble in future, and so on. The articles were there for anyone to read and report on. If they didn't produce sensational headlines, it was mainly because there was nothing to get excited about. The industry was taking corrective measures before any real harm seemed to have been done.

It seemed to be generally agreed that, even with the "bad" sets, the nature and direction of the rays was not likely to affect the viewers. Far from being exposed to the rays because they were in front of the set, they were rather effectively protected from them by a lot of rather thick glass and by the intervening distance.

Servicemen do, of course, pry around the rear of receivers — but not necessarily for long enough to accumulate a dangerous dosage.

The most likely "victim" might possibly have been the family cat, if it chanced to have found a cosy corner under or behind the offending receiver —line scan noise notwithstanding!

If John Nott's (or rather, Phillip Adams') report had been in a more rigidly analytical style, it might have warranted closer examination. But its rather sensational, cloak and dagger tone very effectively undermines its credibility. If this didn't, the paragraph about the irradiated hand, certainly does.

Not by any stretch of imagination could the potentials present in a television receiver produce rays capable of rendering a substance radioactive. Equipment using very much higher orders of voltage is used to irradiate and sterilise food, grain, seeds, etc., without any suggestion that these items themselves become radioactive.

Several orders of magnitude separate the energy present in any domestic television set from that required to produce definite radioactivity sufficient to react on sensitised film.

A local authority on radioactivity described this paragraph as "plainly ludicrous." And if this paragraph is ludicrous, one has the greater reason to question other aspects of the report which are merely suspect! ■

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Fri., June 26: Interstate passengers fly to Sydney by T.A.A./Ansett.

Fri., June 26: Depart Sydney 11.45 a.m. by B.O.A.C. VC10 jet for Hong Kong and The New Hong Kong Hotel. (Perth passengers fly via Singapore. Passengers from Brisbane, Darwin, Port Moresby fly direct to Hong Kong. New Zealand passengers via Sydney.)

Sat., June 27: Morning at leisure. Afternoon flight to Taipei, thence to the President Hotel.

Sun., June 28: Sightseeing Taipei.

Mon., June 29: Colour TV plant at Ta Tung. Afternoon to Tokyo.

Tues., June 30: Tokyo, technical and sightseeing tour.

Wed., July 1: Leisure day in Tokyo.

THURS., JULY 2 to FRI, JULY 10: Depart Tokyo for an exclusive and action-packed 9-day tour of spectacular Japan, including two complete days at the EXPO '70 site, Senri Hills.

Sat., July 11: Morning flight from Osaka to Hong Kong.

Sun., July 12: Harbour cruise, Hong Kong.

Mon., July 13: Leisure, Hong Kong.

Tues., July 14: Duty-free shopping. Evening flight to Sydney.

Wed., July 15: Arrive Sydney 6.50 a.m. (Perth passengers return via Singapore. Passengers from Port Moresby, Darwin and Brisbane fly home direct. New Zealand passengers return via Sydney. Other interstate passengers fly home by T.A.A./Ansett.)

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FLASHOVER PROTECTION
for transistorised TV circuits

The possibility of flashovers occurring in cathode ray tubes has been a cause of concern to designers of associated circuitry using transistors. This article describes a system designed to minimise the effects of such flashovers.

By B. Eastwood
Thorn Radio Valves and Tubes Ltd.

Despite rigorous attention, during the manufacture of cathode-ray tubes, to cleanliness and other factors an internal flashover may still sometimes occur in a small percentage of tubes. These occurrences are so infrequent that they are not likely to be noticed by a viewer, but, from the point of view of the circuit designer, the situation is more serious.

The internal and external coatings of the bulb of a TV, monitor or radar cathode-ray tube form a capacitor, usually of the order of 1000pF, which, in use, is charged to more than 10KV. If a flashover takes place, the energy stored in this capacitor is released and, unless suitable protection measures are adopted, can cause damage to components and wiring in the associated circuitry. The risk of damage is greater in equipment using transistorised circuitry where the voltages and currents appearing during flashover are far beyond those which can be tolerated by semiconductor devices. It is to provide adequate protection under these circumstances that the Sparkguard R base is being made available on cathode-ray tubes manufactured by Thorn Radio Valves and Tubes Limited.

Tubes fitted with the Sparkguard R base must on no account be used in equipment which has not had the necessary components and circuit modifications incorporated otherwise damage to circuit components and, more especially, to the tube itself, can result.

In external appearance, the Sparkguard R base resembles the standard B8H base used on cathode-ray tubes except than pin 5, which is absent on the B8H base, is included. This pin is used to make contact to a metal ring inside the base in close proximity to the pins, so providing a low-voltage spark-gap on each pin. In operation, pin 5 is connected directly to a point on the tube's external conductive coating. In the event of an internal flashover to a particular electrode, for example the focus electrode a3, the gap between the pin connected to this electrode and the metal ring ionises, forming a low impedance discharge path which by-passes the external circuitry.

To speed the firing of the gap and to reduce still further any transient passed into the external circuitry, a resistor is connected in series with the external connection to the pin (e.g. a3), in close proximity to the socket.

Figure 1 shows all internal and external connections of the Sparkguard R for a typical television or information display application. Two separate connections must be made to pin 5, one from the external conductive coating of the bulb and the other from a convenient chassis connection, preferably in the video output circuit wiring. The connection to the conducting coating of the bulb (the "aquadag") must be kept as short and direct as possible and braid is used to give the lowest possible self inductance. There should be no other connection from the aquadag to chassis.

The chassis point from which connection is made to pin 5 should be treated as a "star-point" in the wiring; that is, it should be the point to which all chassis returns associated with the circuitry of the cathode-ray tube and its decoupling, should be made (with the exception, as already mentioned of the aquadag connection). Thus, to this point should be connected one terminal of the heater and any decoupling capacitors associated with the g1, a1 and a3 supplies. The HT supply to the video amplifier load should also be decoupled to this point. The purpose of this "star-point" method of wiring is to minimise coupling of chassis currents into the circuit.

Figure 2 illustrates the Sparkguard R system in a form which bears a closer resemblance to a practical layout but, for clarity, only the connections to cathode (k) and first anode (a1) are shown. The series resistors (of which only R3 and R7 are shown) are mounted close to the tube socket. The decoupling of supply rails to the chassis "star-point" O is also shown.

Suppose that, in the example of figure 2, a flashover takes place between electrodes a2 and a1. The gap between pin 3 and the ring ionises as previously described and a high current

(Continued on page 95)

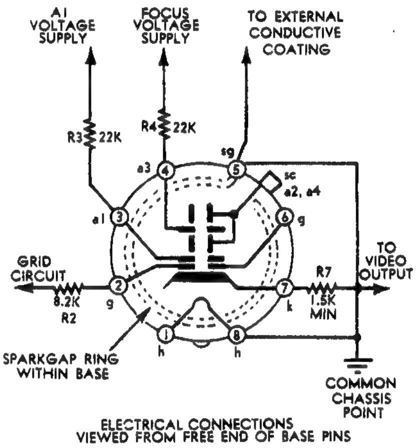

Figure 1. Base connections for the B8H Sparkguard R tube.

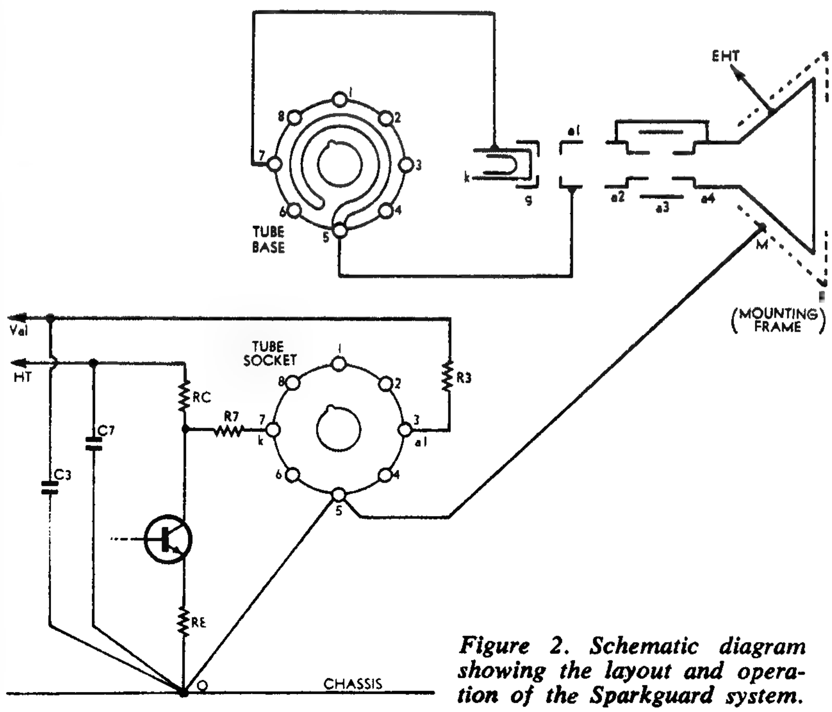

Figure 2. Schematic diagram showing the layout and operation of the Sparkguard system.

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	1.4 V	1000VDC 500 VAC	1.4μA	1.4mA	1.4A	1.4kΩ	1.4MΩ	1.4GΩ	1.4V	140V
Accuracy	DC 0.1% ± 1d AC 0.3 − 1%		DC 0.3 − 0.5% AC 1 − 2%			0.2 − 0.4%		0.5 − 2%	5 − 20%	
Frequency	10 Hz − 1 MHz		10 Hz − 200 kHz						100 kHz − 700 MHz	

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pulse is passed through the connection from pin 5 to M, the contact with the external conductive coating. The nature of some of the resultant effects is better appreciated when it is realised that pulses of current in excess of 200A have been recorded under these circumstances. The inductance of the lead pin 5 — M is sufficient to develop a pulse voltage of several KV at this instant and, if a direct connection were made from point M to chassis, the ring would be pulsed positive by the IR drops around the circuit. This pulse voltage on the ring would have a duration of the order of that of the discharge period of the tube capacitance and would be applied via the low impedance of the ionised gap to pin 3 and any circuit connected thereto. In addition, there would be the danger of secondary breakdowns from the ring to other pins.

For these reasons, the chassis connection is made, instead, from pin 5, and therefore no significant current flows between point O and pin 5. To a first approximation this holds pin 5 and the ring at chassis potential while point M is pulsed to a high negative value.

This is only approximately true. Because of its bulk, the tube aquadag coating has a capacitance to chassis of the order of tens of picofarads and there are thus two paths in parallel from pin 5 to M. One is the direct connection and the other comprises the pin 5 to chassis connection in series with the chassis-to-aquadag (M) capacitance. The pulse of discharge current therefore divides itself between the two paths, but the major fraction still passes by the direct connection.

A significant voltage can, nevertheless, be developed along the connection from pin 5 to point O and hence this lead must be kept as short as possible. To prevent any pulse which appears on the pin to which flashover has occurred (i.e. pin 3) from being passed into the external circuitry, a decoupling capacitor (i.e. C3) should be provided from the supply lead to the chassis connection O.

The above discussion has concerned itself with flashover to an electrode connected to a network such as the first anode supply comprising only passive components. The case of flashover to a pin connected to a network containing active components, particularly a transistor, requires further consideration.

Active components, especially semiconductors, are particularly susceptible to damage by flashovers. As an example of this type of damage, consider a flashover to cathode which, in the circuit of figure 2, is connected to a transistor video amplifier via pin 7.

If no steps were taken to protect the transistor, the full energy of the discharge would be passed to the collector and the device would almost certainly be destroyed. If the Sparkguard R base is used with the connections as previously described, very effective protection can be achieved. On flashover, the gap associated with pin 7 ionises as previously described and the discharge path is completed via the ring and the connection from pin 5 to the point M. As in the earlier example, the series resistor (R7 in this case) ensures rapid firing of the gap. A high-voltage pulse, therefore, only exists on pin 7 until the gap fires.

Any high-voltage pulse on pin 7 appreciably in excess of the maximum collector voltage rating will cause the transistor to break down, and the current flow in the collector-to-base junction takes place at a voltage roughly equal to the breakdown voltage. Whether or not the transistor wafer is permanently damaged depends upon the total energy dissipated during the reverse current flow. The contributory factors are therefore the amplitude and time duration of the current pulse and the voltage drop across the junction.

It can thus be seen that the resistor R7 achieves two useful objectives:

(a) by causing the gap to fire rapidly it reduces the time duration of the high-voltage pulse on pin 7 and so reduces the time duration of the current flow into the transistor; and

(b) the presence of a series impedance reduces the amplitude of the current.

It will also be clear that transistors should not be used having a collector breakdown voltage higher than that required for normal operation. Indeed, for a given size of wafer, the higher the breakdown voltage, the more liable the transistor will be to damage by flashover.

For normal television applications, R7 is required to be at least 1.5K or preferably 1.8K. This is usually the highest value tolerable from bandwidth considerations; but if conditions of use permit a higher value, so much the better.

Due to the presence of stray inductance and capacitance, the initial positive-going voltage peak which appears on the base pin at flashover is usually followed by a negative overswing of much lower magnitude. This negative voltage, when applied to the collector of the transistor, brings the collector-to-base junction into forward conduction and applies the voltage as a reverse bias to the base-to-emitter junction, with consequent risk of damage. To minimise this risk, the impedance between base and chassis should be kept as low as possible.

As previously explained, a connection should be made from the aquadag to pin 5 and from pin 5 to chassis, with no other connection from the aquadag to chassis. It is equally important that the tube should be mounted so that the aquadag is nowhere sufficiently close to chassis or other components for a breakdown to take place through the air when the aquadag is pulsed negative during an internal flashover.

In the case of tube types fitted with an implosion-protection frame or mounting frame carrying lugs, this forms another capacitance to the internal coating of the bulb. If the frame F (figure 2) is connected directly to chassis, the discharge current of this capacitance, on flashover, flows in the connection from point O to pin 5 with the danger of damage from this cause as already explained. The capacitance of the frame is usually of the order of one-third of the capacitance of the aquadag, so the effect is by no means negligible.

If the frame is connected directly to the aquadag with no other connection to chassis, the effect is simply that of increasing the capacitance of the aqua-

(Continued on page 191)

RADIO, TV INTERFERENCE

. . . a matter which needs urgent attention in Australia

Our Assistant Editor reports on a Radio Interference Workshop, sponsored by the University of New South Wales and the Institution of Radio and Electronics Engineers Australia, and held at the University of New South Wales on the 17th February. It documents, very effectively, the remarks made in our February editorial.

By Philip Watson

The workshop was divided in four sessions. It commenced at 9.30 a.m. and finished at 5.30 p.m., with breaks for morning tea, lunch, and afternoon tea. A total of eight technical papers were presented, each paper being followed by a period for questions and discussions.

There was an excellent attendance, amounting to some 150 industry representatives, many from country areas and interstate. It was described by the organisers as a "sell out" and was, in itself, a striking indication of the importance with which all sections of the industry view the problem of interference. This was evident, not only in the formal sessions, but also by the informal discussions during the tea and lunch breaks.

The organisers plan to publish a full report on the workshop, including the papers and the discussions which followed them. In the meantime, the following brief summary of each paper will give some idea of the range of interference problems discussed and, more importantly, the seriousness of the problem which is revealed by many of the facts and figures quoted.

COMPUTERS PREDICT INTERFERENCE PROBLEMS

Paper 1 ."VEHICLE GENERATED ELECTROMAGNETIC INTERFERENCE," by J. M. Waldron, Army Research Establishment.

In this paper the author pointed out that, although industrial background noise makes a significant contribution to the man-made noise field in some areas, as far as the Army is concerned, it has been established that vehicle generated interference is usually the major contributor. The ignition system is the main source, but other sources are important, particularly when communication or electronic equipment is installed in the vehicle.

By using elaborate mathematical models and appropriate computer programs it is now possible to ensure both the design and operational effectiveness of communication and electronic systems in the military environment.

The author went on to deal, in detail, with the mechanism by which interference is generated, particularly by the ignition system, and the paths by which it reaches the receiver. Equally, he dealt with the various methods of suppression, including distributed resistance in ignition HT cables. In this latter regard mention was made of the reliability of such cables and the recent development of a ferrite core HT cable which has superior mechanical characteristics, as well as superior suppression qualities at the lower communication frequencies, i.e., 2 to 4MHz.

On the broader approach, the author listed five basic components used for vehicle interference suppression; capacitors, resistors, L-C filters, shields, and bonds. Each of these were dealt with in detail. Suitably employed, in various combinations, these components were capable of providing a very high degree of suppression. However, the cost and complexity which could result meant that extreme orders of suppression were reserved for fighting vehicles and those used in tactical areas.

The paper concluded with a brief description of interference measurement techniques and the problems which they present, which are considerable, but pointed out that the simpler suppression techniques were adequate in a great many cases.

INTERFERENCE FROM HIGH VOLTAGE LINES

Paper 2. "RADIO INTERFERENCE FROM EXTRA HIGH VOLTAGE LINES," by J. L. W. Harvey, State Electricity Commission of Victoria.

As the name implies, this paper dealt mainly with extra high voltage lines (100KV and higher) and the major source of interference generated by them, which is corona discharge. The author dealt at length with the levels of radio interference likely to be generated by such lines, the methods of calculating these levels when such lines are in the planning stage, and the methods of measuring the actual level when the line goes into service. Where calculations show that the level is likely to be higher than desirable, the route of the line is planned, as far as possible, to avoid areas where interference would be a problem. Lines operating at 750KV or higher would come into this category.

The paper also dealt with interference caused by faulty insulators, loose hardware, poor contact between current carrying parts, between conductors and insulators, between insulators and conducting parts at earth potential, or between metal parts attached to insulators, such as associated with disc insulators in a string. These are the predominant causes of interference in lower voltage (below 100KV) sub-transmission and distribution lines. The far greater mileage of these latter lines produces many more points at which such interference can be generated.

The author described the effect of such interference in TV reception as ". . . . a band of dots across the upper half of the screen and a similar band across the lower part of the screen. The position of these bands of dots will move through the picture, at a rate equal to the difference between the frame frequency and the power system frequency."

Means of locating such sources, and dealing with them when found, were also discussed. It was pointed out that location of the source is frequently the most difficult part. Remedial action depends on the condition discovered, and includes tightening loose hardware, washing polluted insulators and possibly coating them with silicone grease, and coating metal parts with graphite grease to improve conduction between them.

Mention was also made of a "Code of Practice" prepared by the Australian Inter-Departmental Telecommunications Advisory Committee. This is for use by Commonwealth Government Authorities and electricity supply authorities. The code shows the conditions which are desirable to protect the operation of radio stations from the effects of nearby power, telephone, or control wires.

HIGH INDUSTRIAL NOISE LEVEL AT DARWIN

Paper 3. "CASE STUDIES OF INTERFERENCE AND NOISE SOURCES IN THE HF BAND," by D. F. Fyfe, Department of Supply, and G. E. Lyons, Department of Defence.

This paper described measurements made in the Darwin area to determine the level of radio noise on a communications station and to compare this noise with the level at sites distant from man-made noise. The measurements were made in the HF band, principally at 5MHz.

Measurements made at the Naval Communications Station, Coonawarra West, Darwin, gave a value of —24dB for noise field strength. This is regarded as a high level of external noise. It is man-made and arises from electrical equipment within the station, nearby industrial and domestic equipments, and power lines. It is expected that the level will increase as further industrial development takes place.

Measurement made on the Shoal Bay Peninsula, approximately 10KM north-east of Coonawarra West and 15 to 17KM from the Darwin city area gave a noise field strength of —42dB. Further measurements made at Tumbling Waters, 40KM south of Coonawarra West, gave a figure of —46dB. The author points out that the latter figure was taken at such a distance from power lines, etc., that it can be regarded as the residual level for atmospheric noise.

The author also draws attention to the presence of a 66KV power line

which passes close to the Shoal Bay Peninsula area and which is a potential source of noise. Measurements were made to determine the noise level at various distances from the power line and it was found that the level was down to —42dB at 640 metres. This level is surprisingly low and is attributed to the fact that the line is a new one, uses galvanised steel supporting towers an adequate number of insulating discs, and efficient earthing at towers and substations.

By comparison, measurements made in the vicinity of an 11KV line gave significantly higher readings (figures are given). This is attributed to the fact that the line is old and supported by stobie poles, resulting in poor electrical contacts and inefficient earthing.

The latter part of the paper dealt with the problem of interference from adjacent HF transmitters.

SYDNEY INTERFERENCE IN NEW ZEALAND

Paper 4. "ELECTROMAGNETIC INTERFERENCE CAUSED BY INDUSTRIAL USERS OF RADIO FREQUENCY GENERATORS," by R. H. Mondel, University of Sydney.

This paper was devoted to the problem of spurious radiation from industrial and medical RF heating systems and, most particularly, the need for legislation to control these devices. In his opening remarks the author stated:

"The proliferation of communications facilities has produced a state of affairs which seems certain to limit further developments. As is the case with so many of our natural resources, the electromagnetic spectrum has been used wastefully, and so littered with electromagnetic 'garbage' that the future development of communications systems (and in fact the preservation of existing systems) is in jeopardy."

The author went on to describe the circuitry and construction of typical industrial RF generators and to show the many ways in which they transgressed even the most elementary basic principles in regard to preventing spurious radiation. The reasons for this are economic, no manufacturer being willing to add anything to his equipment which does not improve its industrial performance. Thus there is no attempt made to shield the equipment, to filter the power supply lines, or to ensure that the equipment functions within the band assigned for such devices.

Since the industry is highly competitive, no manufacturer will put himself at a price disadvantage, compared with his competitors. The need for legislation to force all manufacturers to meet suitable specifications is therefore obvious.

In describing typical equipment the author pointed out that power ratings of 50KW were not uncommon and that, even assuming a poor order of radiation efficiency, they could cause very considerable interference. By way of an example, he cited the case of a 15KW unit which interfered with essential radio services in New Zealand. He added: "The possibility of aircraft accident due to interference with communications systems is very real."

The solution to the problem is given as the use of crystal control to confine these spurious radiations to the bands set aside for them, plus automatic load tuning to compensate for the varying

load conditions and make crystal control a practical proposition. For the reasons already given, these specifications would have to be enforced by regulation.

The author concluded:

"We have two alternatives. Either we must treat industrial radio frequency equipment on the same basis as any other licensed communication service, or we must suffer a steadily increasing amount of interference which seems likely to threaten many other communications services."

AUSTRALIA BEHIND OTHER COUNTRIES

Paper 5. "MEASURING METHODS AND STANDARDS FOR ELECTROMAGNETIC INTERFERENCE," by I. Shearman, Australian Broadcasting Commission.

This paper opened by drawing attention to the almost complete lack of Australian standards for the measurement of interference levels. The author stated:

"The problem is acute in Australia because existing standards are very poor. Some overseas countries are well advanced in this field, and the purpose of this paper is to present the various possible methods which may be used for measurement of electromagnetic interference."

He then listed three overseas standards which might be considered for possible adoption by this country, viz.:

(a) The International Special Committee on Radio Interference Standards (CISPR), together with International Electrotechnical Commission documents on Immunity.

(b) The current U.S. military standards.

(c) The current British Standards.

Then followed a resume of each of these standards, including the advantages and disadvantages of each. If nothing else, this served to emphasise the magnitude of the task, regardless of which system was employed. The remainder of the paper was devoted, at some length, to: "The Selection of a Suitable Standard for Australian Conditions." From this discussion it would appear that no one set of standards is ideally suited to Australian conditions. The set which the author seemed to favour, the U.S. military standards, would appear to be by far the most comprehensive, but the author admits that they are so loaded with military jargon that they would have to be completely re-written for civilian use in Australia, or elsewhere.

It perhaps should be added that the author is a member of the Australian Standards Association sub-committee currently considering the problem. While the adoption of a particular set of standards will not, in itself, offer any relief to sufferers of interference, it is essential to have suitable standards available before there can be any thought of legislation to control interference.

100KW UNLICENSED TRANSMITTER

Paper 6. "INTERFERENCE TO RADIO COMMUNICATION SERVICES," by E. Roberts, Radio Inspector's Branch, Sydney.

As the title implies, this paper dealt mainly with interference to commu-

nication services and, more specifically, the internal VHF services. Within this field, a large percentage of interference problems are due to spurious radiation from transmitters and receivers, the problems of shared channels, "mixing" produced by external rectification, and radiation from industrial and medical radio frequency generators.

In regard to the latter the author stated:

"Interference from industrial RF generators is one of the most difficult faced by the Radio Branch. Frequency analyses of the output of some of these devices indicate high orders of frequency instability and extremely high harmonic radiation levels. Frequency shifts of 3 to 5MHz are quite common and radiation levels at the sixth harmonic of up to 1 volt/metre at 100ft and 60uV/M at one mile have been measured . . . RF powers of up to 100KW are generated in some machines and the resulting radiation can propagate over long distances.

"As an example, one case concerned a plywood bonding machine in Sydney that resulted in interference complaints from Air Radio Service operators in New Zealand and Fiji.

"Every effort is made to seek the co-operation of the operators of these machines and suppression methods are recommended by the Radio Branch to suit each installation. However, the cost may be uneconomical, resulting in varying degrees of opposition to their implementation."

The author added that the Radio Branch investigates and makes recommendations in some 2,000 interference cases yearly, originating from domestic, industrial, and power reticulation services. The bulk of these complaints are submitted by broadcast listeners and TV viewers.

In answer to a question, at the end of the paper, Mr Roberts advised that the largest number of interference sources affecting domestic radio and TV receivers was due to faulty power lines.

INTERFERENCE FROM RADAR

Paper 7. "CASE STUDY OF ARS RADAR INTERFERENCE WITH AN IBM 360 COMPUTER," by N. Taylor, IBM Australia Ltd.

This paper dealt with a rather specialised form of interference and, in fact, covered one specific case history; the malfunction of a computer located approximately one mile from the air route surveillance radar at Sydney airport. However, because such radar systems can, and do, cause severe interference in audio amplifiers and similar equipment at much greater distances, the subject has a much broader interest.

The author discussed those parts of a computer most likely to be affected by such interference, then went on to describe the specific case. This included a description of the measuring equipment used to determine the field strength of the interfering signal and to check the effectiveness of preventative measures. No suitable equipment was available in Australia, and this had to be imported from the U.S. It was calibrated at the C.S.I.R.O.

The radar system operates on 1.3GHz and has a peak radiated power of 2MW fed to a 32dB gain antenna. Measurements at the computer site indicated interference field strength of 60V/M. Initially, shielding a glass window in the relevant equipment cabinet cured the trouble, but the field strength as measured was several times higher than the recommended maximum for completely reliable operation. A more satisfactory cure was achieved by screening an entire wall between the computer and the radar site.

100 MILES TO SEA TO ESCAPE NOISE

Paper 8. "RADIO INTERFERENCE IN NAVAL ELECTRONIC SYSTEMS," by R. T. Garrett, Garden Island Dockyard.

This was another specialised paper, dealing with the problems created by extremely dense packaging of electronic and electrical equipment on board a modern warship. The close proximity of receiving aerials to transmitting aerials, radar, navigational aids, and electrical machinery, presents problems of a kind not normally encountered elsewhere.

The author dealt with these problems in detail, and described the various measures adopted to control them, and the methods of determining the overall effectiveness of the various systems after corrective measures had been taken.

It is noteworthy that, while a good deal of this work can be done while the ship is in port, the final evaluation must be made at sea. The author states:

"At the completion of new ship construction or following major refitting it is necessary to determine if any interference problems exist. This requires that all systems be placed in operation under normal operating status and within a known environment.

"Environmental noises in populated areas has been found to be excessive for interference trials, as the high ambient noise levels mask interference problems which may become evident in low noise areas. Thus it is necessary to conduct trials in an area remote from civilisation, usually about 100 miles at sea."

SUMMARY

Paper 9. "SUMMING UP," by Professor R. M. Huey, University of N.S.W.

In summing up Professor Huey paid tribute to those who had worked so hard to organise the Workshop, and expressed gratification at the very large response — almost total — to the invitations to attend. The only section of the industry which had not accepted the invitation was the automotive industry.

Professor Huey went on to stress the serious nature of the interference problem as revealed by the various papers presented and to emphasise the need for controlling legislation. He stated:

"There is no doubt in my own mind that Australia is greatly lacking in the technical and legislative documentation and in expertise in applying the available knowledge of electromagnetic compatibility. It is good to see the Standards Association of Australia making a start on the needed technical specifications. It is to be hoped that Government authorities will co-operate and be active and wise in the creation of needed legislation. Activities such as this Workshop sponsored by the Institution and the University will help in sharing knowledge and in advancing the state-of-the-art in Australia."

THE SERVICEMAN

This beat oscillator wouldn't beat!

This month, the Serviceman gets involved in a wide range of frequencies: In RF and IF in a communication receiver, in an audio system and, finally, in 50Hz power wiring. The communications receiver was one of those unexpected, impromptu jobs.

Like most other servicemen, I get hooked at times on the electronic problems affecting friends and relatives.

Without warning of what was to follow, I paid a visit to a friend who has a hobby-level interest in radio and who has become rather keen, of late, on listening to overseas short-wave stations. Most of his listening had been done on a 3-band transistor portable but, hoping for better things, recently he bought a second-hand communications receiver. It had very obviously had a rather chequered history and was in need of a complete overhaul, including replacement of quite a few resistors and capacitors. However, since radio was his hobby and since he had bought the receiver quite cheaply, he did not begrudge the dollars nor the hours that he knew he would have to spend on it.

Well, knowing what he was working on, I asked him about progress on the receiver — as much as anything by way of conversation. Perhaps I should have known better

The receiver was working well, he told me, but one thing had him really stumped — the beat frequency oscillator. To be sure, he had no immediate interest in CW stations and therefore did not really need the BFO but to have the receiver right, except for the BFO, was frustrating, to say the least.

"Come out and see what you think of it," he said.

I was hooked!

Looking at the receiver, and listening to it, I had to admit that he had done an excellent job of restoration. The panel and case had been repolished and the controls were all as smooth as they had ever been. More importantly, stations came rolling off from all directions.

But I had to admit that the BFO was poor, very poor.

On weak stations it superimposed a discernable heterodyne, the pitch of which could be varied, as normal, by the BFO pitch control. But on strong stations the heterodyne could hardly be heard at all. My friend assured me that he had measured the voltage and current to the beat oscillator, had changed the valve and checked all the components.

Everything seemed normal — except its operation!

Hardly before I knew what was happening, he had the receiver out of its case and upended on the work table.

Just to see what would happen, I took a length of hook-up wire and pushed one end up inside the BFO coil. The other end, I looped around the plate lead of the mixer. With all that coupling, any respectable beat frequency oscillator should have completely swamped the IF channel but no — the heterodyne remained virtually as weak as ever.

"Do you know if the oscillator is on frequency?" I asked.

The question seemed almost a silly one, because the BFO was clearly producing a heterodyne in the IF system. My friend came back with the obvious retort:

"Surely it must be. But I'd have no way of checking it, anyway!"

With this I started to agree, but then the penny dropped. Or, should I say, the cent dropped?

"If you loop that wire around the aerial connection and tune across the broadcast band, you should hear one of the harmonics of the oscillator."

"Looks like metal fatigue." (RCA "Electronic Age").

No sooner said than done, we switched the receiver to the broadcast band, turned on the BFO and tuned downwards from the low frequency end. And just near 1360KHz ... whoosh! A "blotto" signal swamped the receiver and drove the S-meter as far beyond S9 as it was ever likely to go.

What a harmonic! But if this was the third harmonic of 455KHz, what had happened to the second harmonic in 910KHz? We rechecked but there was no sign of it. Nor could we find any sign of the fourth harmonic on the next band, on 1820KHz.

What we did find was another strong signal from the BFO on 2700KHz odd. If these figures were to be believed, the BFO was not on 455KHz but on three times this frequency — 1360KHz. The heterodyne we had been hearing was presumably the beat with the third harmonic of the IF, generated mainly in the detector. No wonder it was weak and no wonder the BFO would not swamp the IF channel!

Clearly enough, either the set was fitted with the wrong BFO coil or a shunt capacitor had been removed and lost sight of during the previous owner's "experiments." Since the coil had every appearance of being an original component, I was inclined to favour the latter explanation.

Knowing that one commonly used a tuning capacitor of 400-odd picafarads to run a coil like that over the broadcast band to 550KHz, I reckoned that .001uF would be a good guess for the missing capacitor. Raking through his capacitor tin, my friend came up with what I recognised as a silvered-mica capacitor branded .001 and, short of a low tolerance plastic component I could hardly have asked for anything more suitable.

With this capacitor soldered across the BFO coil, we switched on again and ran the core through its travel. Suddenly, Whoosh! This time, there was obviously no need for the extra coupling wire. The BFO pushed ample signal into the IF channel without need for such assistance. In fact, it worked just fine.

To say that my friend was delighted would be to put it mildly. In fact, he was showing such enthusiasm for the crowning touch to his communications receiver venture that I would not be in the least surprised to find him studying the Morse Code — just so that he can use the BFO!

But, for me, I must confess that it was a first. While I've worried on odd occasions about "Joeys" in broadcast receivers on 930KHz — the second harmonic of the old-time 465KHz — I'd never thought of a BFO getting involved with them.

If it was a first, the chances are that it will also be a last! One certainly doesn't meet situations like that very frequently.

While on the subject of "firsts," I struck another one during the month.

A young lady schoolteacher dropped into the shop a mains-powered portable record player. It was an early stereo unit, carrying a brand name which meant nothing to me, but using components which were readily recognisable. It had probably been made up in a small local factory for a furniture store or electrical chain.

The complaint was that the turntable was unreliable. Sometimes it would start; sometimes it would not; some-

times it would stop part-way through a record.

When I finally got around to examining the unit, I felt pretty certain that the trouble was in the auto-stop mechanism under the turntable. The contacts were strips of phosphor bronze which were as much dependant for their position on the wiring attached to them as they were on the moulding which was supposed to hold them in place.

What was more, they seemed not to be anything like as springy as I would have liked them to be.

Anyhow, I re-shaped and re-positioned them as carefully as I could and very carefully checked the operation of the whole auto-stop mechanism. It now seemed to operate quite reliably, although I wouldn't like my life to have depended on it.

In due course, the lass picked up the player but, within a week, it was back again. She agreed that it would now start reliably — every time — but it was still given to stopping in the middle of a long-playing record. She would switch it off and next time she tried, it would work again — maybe for half a record, maybe for a whole one! I had to agree that it was hardly a very satisfactory state of affairs.

Next time I addressed myself to the player, I did so at a time when I could leave it running and observe for myself what was supposed to happen. And happen it did: half-way through an LP record, it just stopped dead.

Very gingerly, I lifted the turntable and prodded at the switch. Nothing happened, so I switched off and carefully lifted the cover off the switch to reveal the contacts. When I switched on again, the motor began to spin.

That darned switch again.

Just then the phone rang and when I came back to the bench the motor was stationary. But the switch was still open, so I pushed the contacts and wiggled the wires but the motor remained stubbornly at rest.

And a horrible premonition suddenly gripped me. What if the motor were intermittent?

With this possibility in mind, I propped the motor board up so that I could reach both the switch and the motor leads, and I kept an eye on it while I went on with another job. And there it was — the neatest heat-sensitive circuit that one would see in a lifetime. The motor would start, warm up, then stop. It would cool down a little, start, warm up, and stop again.

I've seen faulty gramo motors, of course, but never one that behaved like that. But what to do about the faulty motor was another thing.

It was a particularly compact unit and had been fitted into a cabinet that provided the barest minimum of clearance both for the edge of the turntable and for the pickup arm. Furthermore, the whole assembly was floating on springs, evidently as a precaution against acoustic feedback from the loudspeakers.

I felt pretty certain that not too many other playing decks would fit into the same space, even assuming that it would be worth my while to get one and go to the trouble of making and fitting a whole new motor board, etc. Yet, if something like this wasn't done, the whole outfit would have to be scrapped.

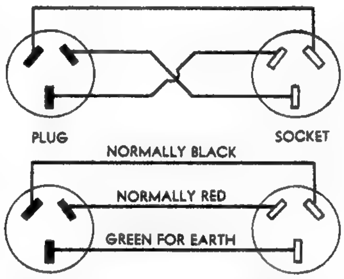
And then I had an inspiration. I remembered having noticed one of the advertisers in this journal selling out a lot of the same players some years ago; it was just possible that he might have one left.

Luck was with me. A telephone call established that he did have just one in stock — one that was unsaleable because the pickup arm was broken and the turntable spindle bent. It had very obviously been dropped or crushed.

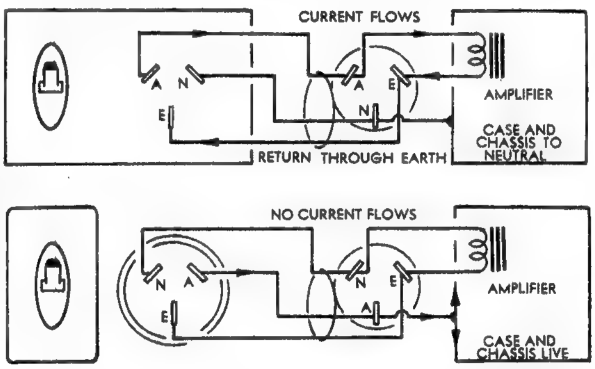
He was glad to get a couple of dollars for it; I was glad to get it and my young schoolteacher client was certainly glad to get a unit that would play records right through without stopping!

So much for RF and audio. The next case is not my own but came to me in the form of a letter from a serviceman who operates in a town in the central west of New South Wales. His story and his diagrams follow.

(For simplicity, the quote marks have been omitted . . . Editor).



At top, how an extension cord was wired and, below, how it should have been connected. The illustration assumes that one is looking at the face of the socket and the pins of the plug. The situation which can arise from a wrongly connected extension cord is indicated below.



By accident, the wrongly connected extension lead caused no trouble with a conventionally connected power point (top). It became lethal with a point having active and neutral transposed (bottom).

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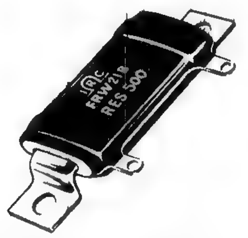

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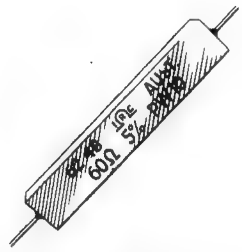

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RADIO: Unofficial history

R.M.'s contribution to "Radio — Unofficial History" ("Electronics Australia," December, 1969) about the sausage on the aerial terminal reminds me of a similar incident.

During World War II I was stationed for some time in the Italian port of Trieste as a wireless operator on a German merchant ship. I became friendly with an Italian family, and when they learned that I was a "radio officer" they asked me to look at their radio. "It was quite expensive," they claimed, "but it is not bringing in the stations very well." I promised to investigate this lack of sensitivity, and at the first opportunity I equipped myself with a multimeter and a few tools and set out to look the set over.

The set certainly seemed to be a recent model, which should have had no trouble in bringing in distant stations, provided an outside aerial was fitted, as was then the practice. The receiver itself checked out quite well, so I followed the aerial lead which was connected to a short outside aerial adequate for the purpose. Next I followed the earth lead. To my amazement, I found the lead terminated in a medium-sized flower pot. Why, I asked, had they pushed the wire into the flower pot? "But signor," they replied, "at the back of the set it says that this lead must go to a "good earth" and the earth in this flower pot is as good as any. In fact, it is better than most, since it has been mixed with much horse manure!"

Another event that comes to mind occurred during a voyage on a Panamanian tanker, in 1936. One afternoon I received an urgent call from the chief engineer. His radio had gone out of action, and would I have a look at it? When I opened his cabin door, I found him bending over his desk with a valve sticking out of his mouth, his eyes nearly popping out of his head, and apparently sucking his fingers at the same time. He appeared to be in a state nearing exhaustion and frustration. When I asked what he was doing, he explained that the grid connection at the top of the valve had broken off and he was trying to restore the vacuum, but he was having the very devil of a job to get the broken tip back into position. I told him that his efforts would be in vain, and he had better buy a new valve in the next port. I don't believe I convinced him, as he was still sucking his valve when I left.

Finally, here is a story about an incident which occurred in my own family. It was in 1924, when we were living in Berlin, and during a visit from my grandmother. Grandmother had lived all her life in a small country town in Pommerania, and had heard nothing of radio. (My father had just built a crystal-type receiver, and proudly showed her the new marvel. Not knowing what to expect, she carefully placed the earphones on her head and listened. Suddenly, with a frightened look on her face, she tore the phones off and threw them into a corner, screaming "There is a devil in this thing." I was too young to remember much of what occurred afterwards, or whether she was reassured that the set was harmless, but I shall never forget her bewilderment. (G.K., Moe, Victoria.)

(Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to re-phrase contributions as necessary to preserve uniformity of style.

Some months ago the power transformer in an amplifier belonging to a local High school "blew up" the day before it was scheduled to provide the public address at the school's annual swimming carnival. I had serviced the amplifier before and, having in mind its age and the life it had led, this did not surprise me at all!

However, it was not the fact that it blew up, but the inopportune time that the trouble occurred that provides the basis for this story. With no possible chance of obtaining a replacement transformer overnight, I managed to organise another amplifier, with its own microphone, loudspeakers and power lead for the school to use next day.

This, however, is by no means the end of the story. The sequel came about two months later, when I was called to the school with the report that one of the boys who look after the P.A. system had received a nasty shock from the original amplifier, which I had repaired in the meantime.

I asked for the details from the teacher in charge: "Well, everthing has worked fine since the thing was repaired after the carnival. In fact, it has never worked better." This was pleasing, because there happened to be a query about a couple of sick valves I replaced at the same time as the transformer.

He continued: "We have been pressuring the headmaster to have an external power outlet put in reasonably close to the rostrum. We had been working from one inside the classrooms with an extension lead. He finally agreed, and it was put in yesterday."

"The outlet — who put it in?"

"The local County Council."

This seemed to exonerate the outlet from suspicion, as council electricians are usually very careful in their work.

I asked for the amplifier to be turned on, and a quick test with a multimeter across to a nearby iron railing confirmed that it certainly was live by the full mains voltage.

Although the onlookers were firmly convinced that the outlet was at fault, I felt pretty certain that it wouldn't be. To prove the point, I checked it with a multimeter. It was quite okay but there was one small thing I did notice. It had been connected using the opposite connection to that which is now the normally accepted convention —but this should not matter at all, because we were dealing with non-polarised AC.

The amplifier itself should not be the cause of the trouble, because I had given it a thorough going over only a couple of months previously, and it had worked perfectly until the change of power points.

That left only one thing — the link between the two — the extension lead. I removed the cover from each end and had a look at the terminations. It didn't take long to spot the trouble: the earth wire and one live lead had been transposed in the cord, as illustrated, in the same way as in the case of a TV set reported in these columns some time ago.

When plugged into the original power points in the school, the circuit was seemingly normal. Using the generally accepted convention (i.e. active on left with earth on bottom facing power point) a current flowed from active to earth and the chassis was connected to the "earthy" neutral line.

However, when the lead was plugged into a point using the opposite connections (active in right, earth on bottom) the equipment remained inoperative because it was connected between neutral and earth. But the chassis was connected to the active line, making it "live" and a potential killer!

Undoubtedly a lesson or two can be learned from this episode; unless you are absolutely sure you know what you are doing, never attempt to repair any piece of electrical apparatus: leave it to a qualified electrician or servicemen.

If you do go ahead and do it yourself, always double and triple check your work. For example, to check an extension cord, connect each end to the other before the covers are secured. Make sure red matches red, black matches black and green matches green. Green should always be used for the earthed pin.

But don't attempt a method like this if you are colourblind — and don't take chances. The life you save may be your own!

Good news from B&O!

the new SP12 magnetic cartridge

It's the symmetrical micro-cross of the B&O SP 12 that makes the difference: reproducing to perfection which has been recorded on your record. The booming of the bass drums or the tingling of the bells makes no difference to this outstanding new B&O cartridge. Due to it's unique design, very high compliance, low tip mass and elliptical stylus it will glide with ease through the record groove and follow faithfully every minute detail without causing damage. Behind the development of this excellent cartridge stands the long experience and undisputed renown of the Danish firm of B&O, your warranty for highest quality.

Specification:

Stylus:	Naked diamond
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Frequency response:	15-25 000 Hz ± 3 dB 50-10 000 Hz ± 1 dB
Channel separation:	Better than 25 dB at 1000 Hz Better than 20 dB between 500-10 000 Hz
Channel difference:	Less than 2 dB
Compliance:	Min. 25 x 10^6cm/dyne
Stylus pressure:	1 gram (2 grams)
Output Voltage:	1 mV/cm/sec. (5mV average from music record)
Load:	47 k ohms
Tracking angle:	15°

Also available is the SP 10 with same specifications but spherical stylus.

BEOCORD 1800

New from B&O the Beocord 1800 tape-deck with specifications on 4 track so far considered unobtainable. Two newly designed hyperbolic heads plus one ferrite erase head provide for extra-wide frequency response and a signal to noise ratio better than 60 dB. Six slide faders for mixing, high/low level inputs from phono-radio (or microphone) - echo make this Danish precision machine outstanding. The 2 track models have 2 and 4 track replay facilities.

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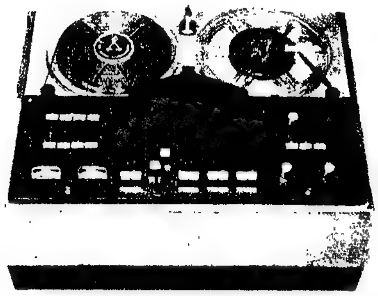

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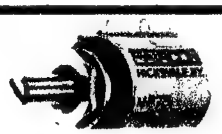

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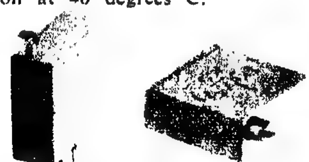

MODELS 6030, 6031 ⅜in CERMET RECTANGULAR TRIMMERS. Available with staggered pin terminals. 20 turns.
MODEL 6120, TYPE RJ24 3-8in CERMET SQUARE TRIMMERS. (above) Designed to meet or exceed MIL-R-22097 or MIL-R-27208. P. W or Y style pins. 27 turns.

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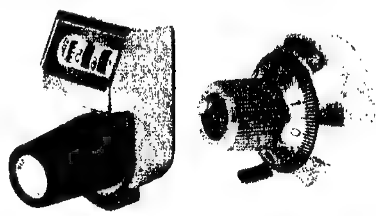

FAIRDIAL MODEL DFD DIGITAL TYPE (Left) and **MODEL DFA ANALOG TYPE** (Right) for multi-turn potentiometers — miniature size/low cost.

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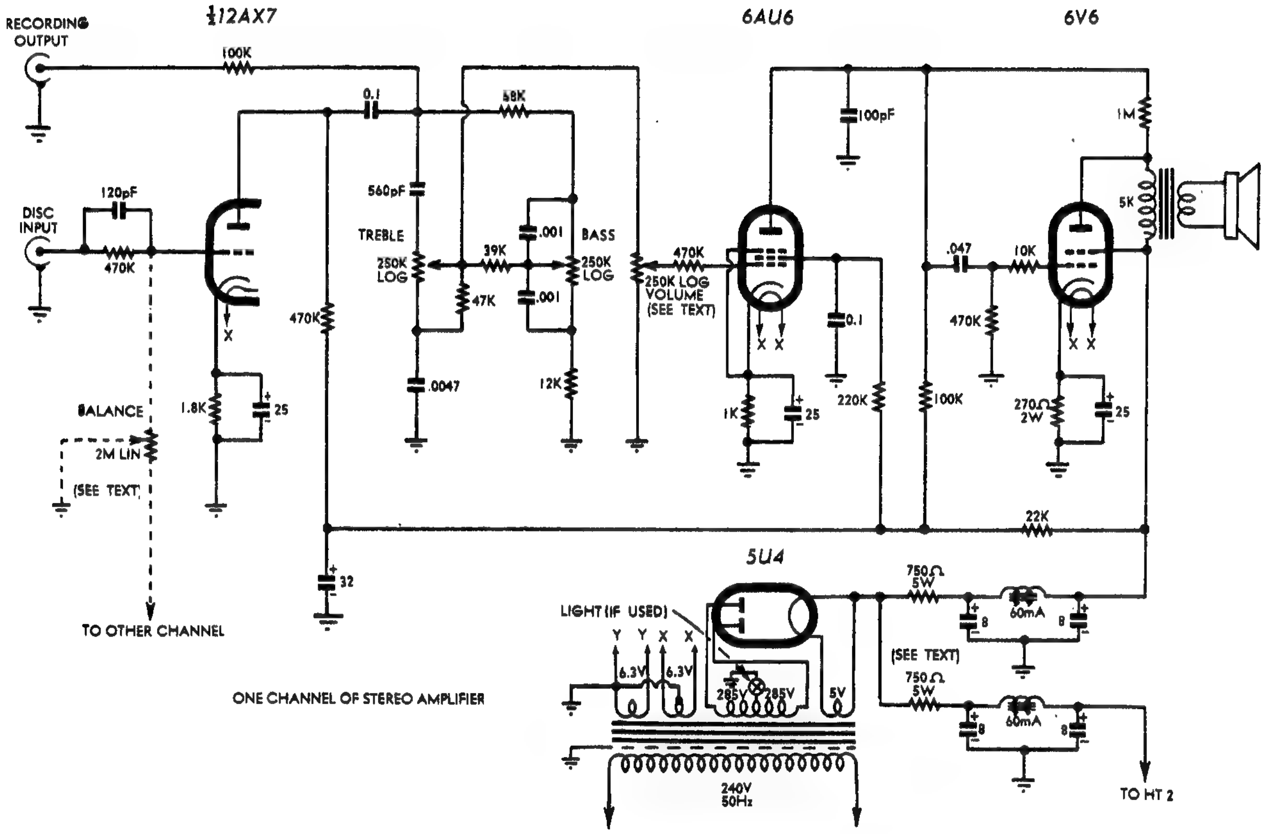
A READER BUILT IT

Valve-type stereo amplifier uses oddment components



ONE CHANNEL OF STEREO AMPLIFIER

This simple stereo amplifier, which may be constructed almost entirely from spare parts, is intended for those who want a fairly cheap unit, but one having quite good quality. It is based on the "Basic Mono Amplifier" published in "Electronics Australia" in May, 1967.

One channel only of the amplifier is shown. The other channel is an exact duplicate of the one shown. Using the transformers shown (with two 6.3V windings), the one marked "x" is used for the left channel and the preamp. valve (12AX7), and the other winding "y" is used for the right channel. The 5V winding is used for the rectifier.

Six 250K log pots are used, two of these being ganged for the volume control. When ganged pots are used, a 2-megohm linear balance pot must be incorporated in the circuit. This is shown dotted in the circuit diagram. If desired, two individual pots may be used for the volume controls, thus obviating the need for a balance control. In this application, the balance pot should be replaced by a 1-megohm or 2-megohm resistor in each channel, each going to earth. If only one channel is built (i.e. a mono amplifier), this resistor should be retained and the circuit (except for the power supply) remains as is.

The power transformer used was an A&R type 1889 which is rated at 285 volts per side at 100mA, with two 6.3V and one 5V winding. Any transformer having similar characteristics would be suitable. Two spare 60mA filter chokes were used, one for each channel. If only one choke is to be used, it must be rated at 120mA and the two resistors should be replaced by a 390-ohm, 10-watt resistor.

Output transformers should be 5K to voice coil impedance. Ordinary loudspeaker transformers are not recommended. The original used 15-ohm loudspeakers.

The chassis should measure approximately 14½in by 7½in. This can be bought complete for around $6. "Radio Parts" supplied the chassis used here for just over $6. No cabinet is needed with this chassis, as it has its own cover.

A 6.3V bezel was placed between the centre tap of the transformer and earth. It primarily acts as a fuse, but also provides a point to measure current drain, and will give warning when the electrolytic capacitors are getting old and leaky. Apart from these uses, a suitable low-current bulb gives warning that the unit is operating, hence may be used as a pilot. For the 10c cost of this lamp, it is a very useful addition. It may be mounted anywhere practical on the chassis.

A few hints on the construction of this amplifier may help. All the components mount directly on to the valve sockets or potentiometer lugs. The only tagstrip used was to anchor the power flex. The chassis is larger than it need be, so that all the components may be

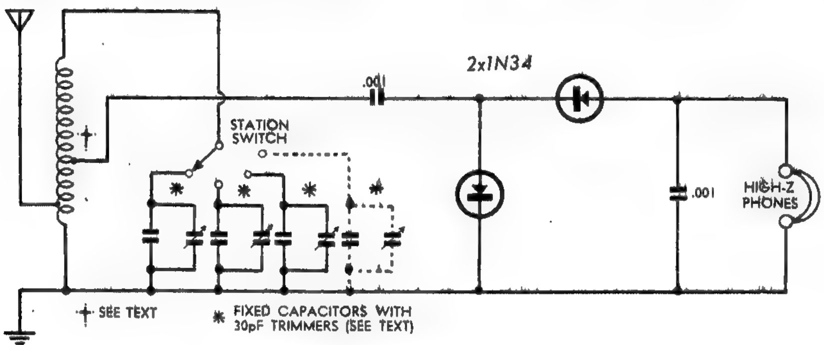
(Continued overleaf)

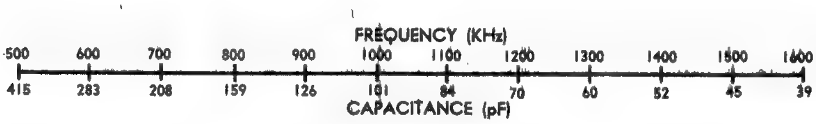
mounted without looking cramped. It will end up a neater looking job if all the components are mounted parallel to one of the sides.

Shielded cable must be used for all connections carrying low level audio signals. It is suggested that the power supply components and valve heaters be wired up first, lashing the wires together where necessary. Then come the volume and tone controls and their associated components, and finally the components mounted on the valve bases. (Submitted by: Mr K. B. Lewis, "Kanda," Boes Road, Hastings, Vic. 3915.)

Crystal set uses selector switch

This novel crystal set uses a switch to tune various stations in place of the usual variable capacitor. Instead of fiddling with a knob to select the station, the flick of a switch tunes the station in "spot on" every time.





Based on an idea submitted to us by a reader (S.H. of Watsonia, Vic.), the crystal set is capable of driving a pair of headphones in the normal way. If the reader wishes to incorporate an amplifier, he could use one of the simple amplifiers described last month. In this case, a resistor of 10K or more would be substituted for the phones. The earthed side of the resistor would connect to the "earthy" input of the amplifier, while the other end of the resistor would go to the amplifier's "live" input connection.

Apart from the "switch-tuned" aspect of this set, another novel feature is incorporated. This is the "voltage doubler" detector, which is claimed to have twice the output of a normal detector using only one diode in series with the headphones.

Although the two diodes are specified as 1N34s on the circuit diagram, they may be almost any of the common type of germanium diode, for example: 0A91, 0A90, 0A85, 0A81, OA80, OA79, OA5, etc. The values of the two capacitors, however, should not be changed.

The coil used in this set may be any coil of a type designed for use from 500KHz to 1600KHz. It may be a commercial type (such as the high-gain transistor aerial coil used in our 3 band transistor 8 receiver), or may be homemade. The details of one such coil are given in "Basic Electronics," chapter 9, page 49. The theory of the crystal set, also described in this chapter, may well be worth while for those contemplating building a set such as this.

For those without "Basic Electronics," coil details are as follows: "Coil wound on 2-inch diameter former. 80 turn 22 B & S wire, close wound and tapped every 5 turns. Approximately 7 taps required commencing from earthy end."

Experimenting with the different taps will give the best position of the aerial and "active" lines. Start by placing the aerial on the 2nd tap and the active on the 4th tap from earthy end. This should give results. Then moving one or the other to a different tap and comparing loudness will help to determine the best position. This setting up would probably best be done using a normal tuning condenser.

The switch used will depend on the number of stations required. An ordinary rotary switch (as shown in the circuit diagram) would be the easiest to use. It would need to have an extra pole and an "off" position only if an amplifier was incorporated, as there is nothing to turn off in a crystal set.

The greatest problem in a set of this type is to determine the amount of capacitance to be used to select the station. Besides the obvious method of a large number of capacitors being substituted by trial and error until the correct one is found, some method of accurately determining the capacitor is required.

One method requires the use of a capacitance bridge. An ordinary 10-415-pF tuning condenser is connected in parallel with either a 15pF capacitor or a 30pF trimmer set at its middle capacitance. This is substituted in the circuit for the switching bank. A station is then tuned (like a normal crystal set) and the amount of capacitance is read on a capacitance bridge. This reading should be of the tuning condenser alone, taken out of circuit. A fixed capacitor of this value (or one very close to it) is put in parallel with the 30pF trimmer and soldered into the circuit.

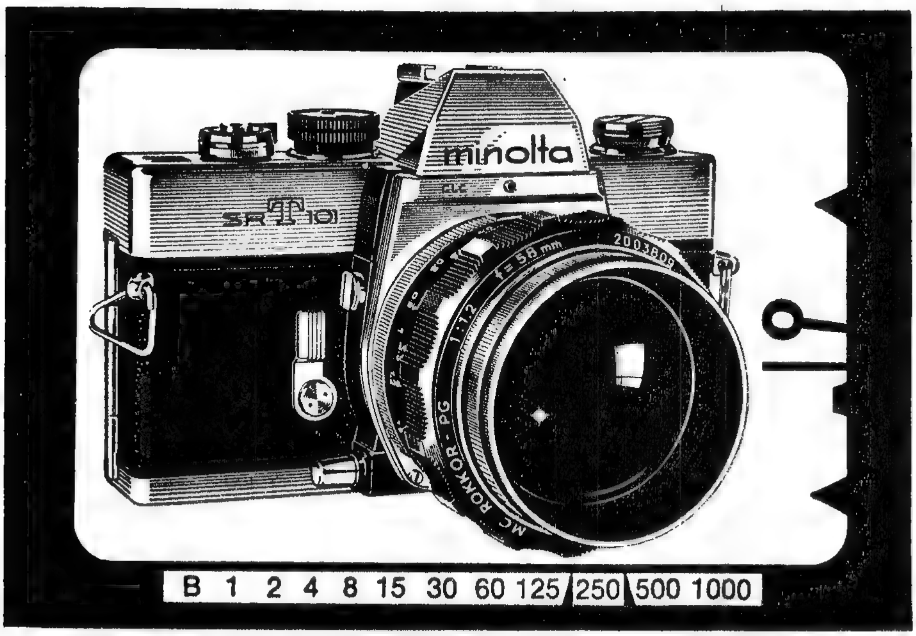
Another method is to use the graph herewith, which has been worked out for a broadcast band coil and a variable capacitor of 10-415pF.

Start by adjusting the coil (adding or removing turns from the switched end) until the lowest frequency station in your area can be tuned with the predicted value of capacitance. For example, in Sydney, adjust the coil so that 2FC (610KHz) can be tuned with just under 283pF in circuit — say 270pF in parallel with a trimmer. Other stations should be received with about the predicted values of capacitance.

To take an example in reading the value from the graph, station 2UW in Sydney has a frequency of 1110KHz. Looking at the graph, we see that 1110 lies somewhere between 101 and 84. As the graph is not a linear function, (i.e. the distance between each unit of capacitance is not a constant), it is necessary to take an educated guess at where the exact figure lies. In this case, 95pF would be close enough. As we are using a 30pF trimmer across this, we must allow for it, by subtracting 15pF (i.e. half the value of the trimmer) from the value we read. So to tune 2UW, we would require approximately 80pF in parallel with a 30pF trimmer.

Setting up now becomes a simple matter of switching the required station in, then adjusting the trimmer for maximum gain. Subsequent tunings will then only require the switching in.

Your eye controls the action



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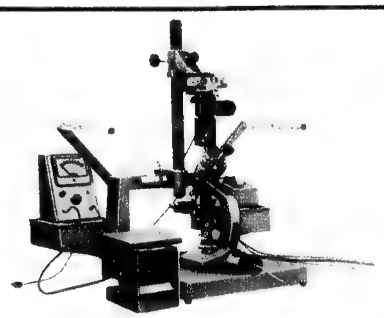

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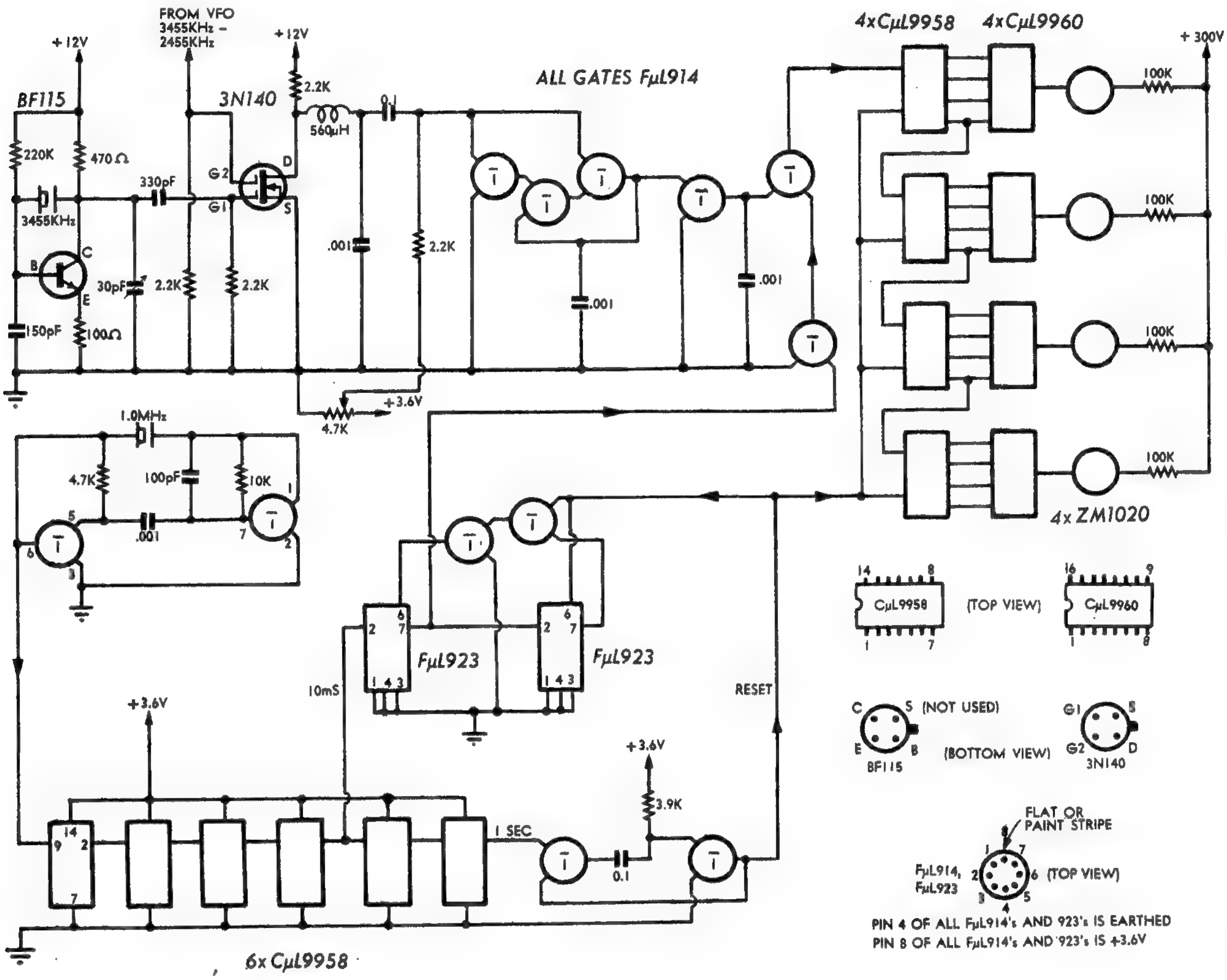
AUTOSPOT

Digital Read-out System for the Deltahet Receiver



A digital read-out unit as per the accompanying circuit has been constructed for use with the "Deltahet" receiver and has been working perfectly for several months. The VFO in the receiver (3455-2455KHz) is mixed with a crystal oscillator on 3455KHz, producing a resultant of 0-1000KHz. This is passed through a low-pass filter and is squared by the two uL914 gates. It then passes through the main gate to a decoder and read-out system. The sycnhroniser opens the gate for 10ms. The 1.0sec reset pulse is shortened by the one-shot multivibrator. (From B. Weidmann, 63 Buena Vista Drive, Montmorency, Vic. 3094).

(Editor's Footnote: "Reader Built It" projects are published for the general interest of experimenters and as a source of ideas. Based on readers' contributions, they have not been tested in our laboratory and we cannot accept responsibility for them.)

EDITORIAL NOTE: The basic design of this system appears to be quite sound, although the cost of such a unit would be quite high, approaching $200. With this in mind, and for those who are not deterred by the cost, a good approach might be to add the 3455KHz crystal oscillator and the mixer/filter to the receiver proper, or as an outboard unit. The rest, which is virtually a complete digital counter, could be built separately. This could be used as a digital read-out for the receiver, or independently double as a frequency counter.

Another point worth noting is that, for the greatest readout accuracy, the 3455KHz crystal would need to be altered where the centre frequency of the IF was not exactly 455KHz.

In cases where a four figure read-out was not essential for readings down to 0.1KHz, one decade could be omitted and the read-out limited to the nearest KHz. A further economy may be possible, by using some less expensive components, such as those used in our Digital Frequency Meter, currently being described.

AUDIO TOPICS

The basic elements of the Moog synthesiser

Now an established part of the recorded music scene, the Moog synthesiser still remains just a piece of terminology to most people. This article outlines the basic elements of the Moog system, and explains how they are integrated to form a complete unit.

by Robert C. Ehle

The contemporary composer or student of composition comes to electronic music with great expectations. Among these are the intention of escape from the necessity of finding sympathetic performers, a desire to escape from the equal-tempered scale, conventional sounds, and musical instruments, and in general, a situation where the available materials for musical composition have been so thoroughly worked that only a genius could find new means of expression in them. Electronic music offers a means to this end.

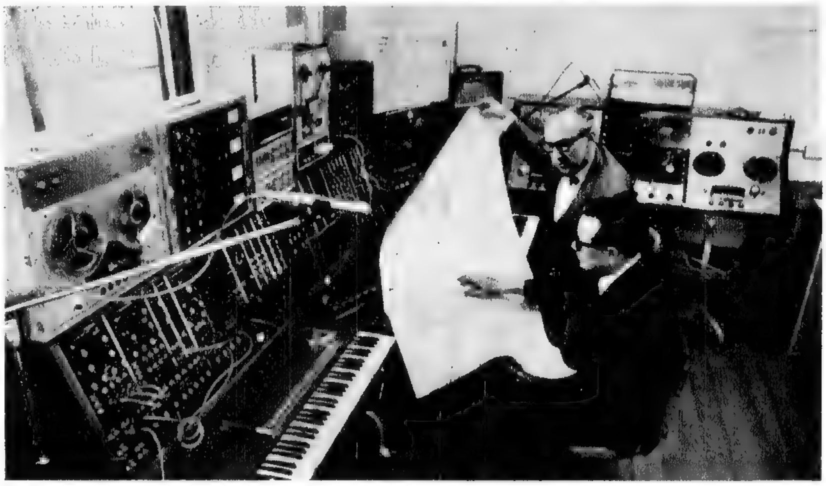
The writer has taught techniques using the Moog synthesisers at North Texas State University for several years.

The university has two Moog synthesisers. The first, essentially a "Synthesiser I," is used for most teaching purposes and is ideally suited for this application because of its relatively simple construction. The other is a special-purpose performance instrument containing special mixing and patching conveniences which facilitate rapid change of sound parameters in real concert situations. They also make comprehension of the instrument difficult for the student. This article describes the "Synthesiser I," actually an earlier version of the model currently available. Differences between versions, while significant, can be avoided in the present material as they do not affect the principles of operation which are the primary concern here.

The purpose of this article is not so much to give directions for specific compositional procedures as to give him a comprehension of the principles of operation of the Moog synthesisers (and other similar instruments).

As a background to the present discussion the reader is referred to the writer's article "Techniques for the Synthesis of Electronic Music,"[1] which covered material in a basic way, unrelated to specific items of equipment.

By arrangement with "Audio"



The Moog synthesiser in use in the electronic music laboratory at the North Texas State University.

Type of Module	Inputs	Outputs
Oscillators	Control	Signal
Controlled amplifiers	Control Signal	Signal
Filters	Signal Control*	Signal
White-sound source	None	Signal
Reverberator	Signal	Signal
Mixer	Signal	Signal
Control Devices	None	Control
Sequence controllers	Control* Trigger*	Control
Envelope follower	Signal	Control

* on some models

Table 1

Detailed descriptions of the components in Moog synthesisers are available in the Moog Electronic Music Composition - Performance Equipment catalogue[2] and the various manuals and specifications sheets supplied with the equipment.[3]

The descriptions given here are general in nature and are intended to tie the technical descriptions to the specific applications in music.

First, the synthesisers are modular in construction. Each module is an independent unit having only power supply circuits internally connected. Thus, the user makes all signal-flow

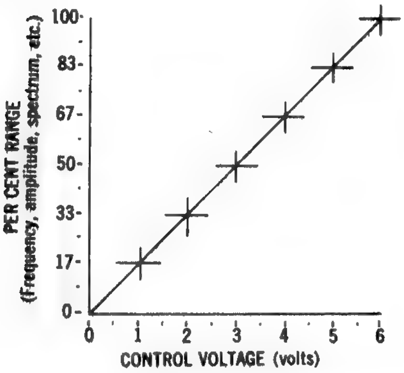


Table 2. Voltage characteristics of voltage controlled modules.

connections on the front panel. A typical synthesiser contains most or all of the following modules:

- Oscillators (two or more).
- Controlled amplifiers (one or two).
- Filters — High-pass, Low-pass, Band-pass (fixed and variable).
- White-Sound Source.
- Reverberator.
- Mixer.
- Control Devices (keyboard, linear controller, etc).
- Sequence controllers (envelope generator, sequencer, paper tape reader ,small digital computer, etc.).
- Envelope Follower.

In a Moog synthesiser, as in any well designed instrument, all modules are compatible which allows all outputs to be connected to all inputs for special needs. In each case, the impedances, voltage and current levels, and frequency responses match so there are no technical limitations on interconnections. The basic justification for any interconnection must come from musical requirements.

The Moog synthesisers are all voltage-controlled. This means that of all the parameters of an input signal to a particular module, only the voltage of that signal exerts any controlling influence on the module's performance. Thus, the same parameter of the control signal is effective with all modules. Also, the degree of control exerted by a control signal is linearly related to the voltage of the control signal in most instances. This means that a given incremental voltage change always produces the same relative change in a module's performance anywhere throughout its entire range. This is described graphically by Table 2, which shows a module's output (oscillator frequency, amplifier gain, filter spectrum,

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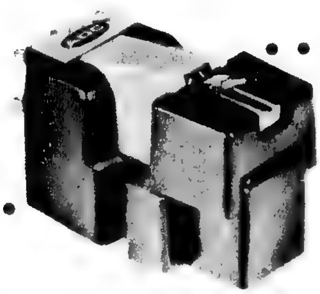

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The world's leading reviewers in the July, 1969 issue of "STEREO REVIEW" (Julian D. Hirsch and Gladden B. Houck) state—"We could not critically compare each cartridge against all of the others, for reasons of time. We had to content ourselves with comparing each with the ADC 25, as representative of the best available, **and it emerged the better choice from each such comparison."** THIS IS NOT AN ISOLATED REVIEW. The top ADC cartridges have been used as a **reference standard** so many times by the real experts (not the inverted comma experts!) that there must be a sound reason for it.

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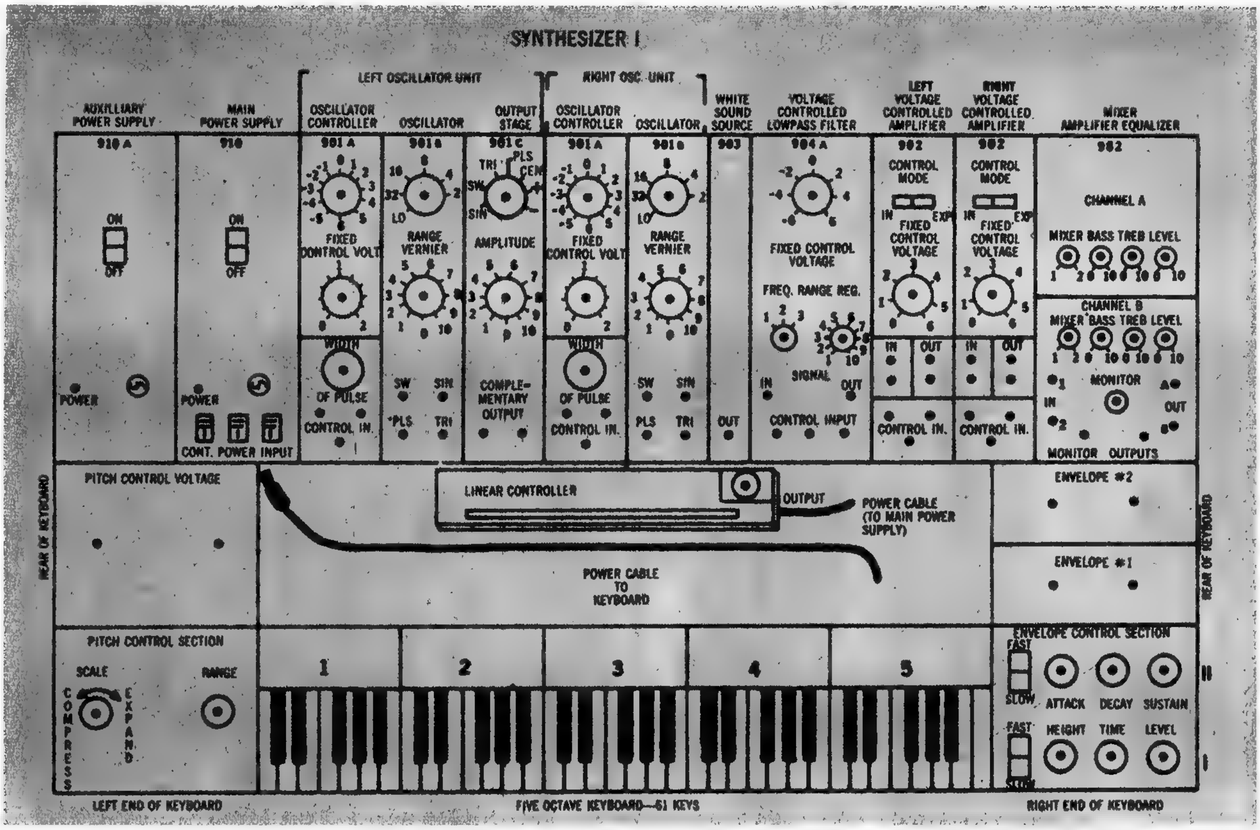


Front panel controls and connectors on the Moog synthesiser at North Texas State University.

and so on) as related to the input voltage.

It should be pointed out here that there are other means of controlling electronic music instruments. The Theremin, for example, is capacitance controlled, as is the complex-tone generator built by the writer[4]. Many units are resistance controlled. This is convenient because the variable resistor, or potentiometer, is a common control device in electronics. There are, however, limitations for controlling one module from the output of another, usually in the form of a voltage or current source. Voltage control is probably the most universal and flexible method of those available and it is a good choice also, because digital computers can be made to have voltage outputs by means of a device known as a digital-to-analog converter, thus making them adaptable to voltage-controlled modules.

The modules in the Moog synthesisers have two types of inputs and two types of outputs, present in various combinations on each module as required. The four types of inputs and outputs are as follows:

- Signal inputs,
- Signal outputs,
- Control inputs,
- Control outputs.

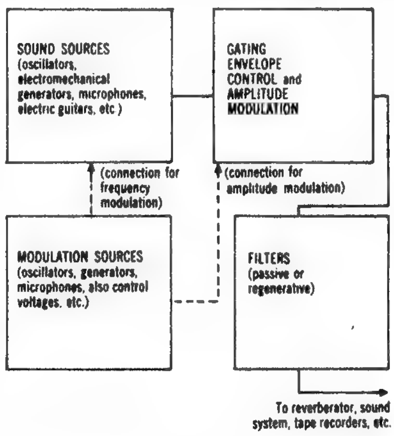
The arrangement of inputs and outputs by type of module is given in the Table 1 (page 112).

The breakdown given above is interesting as it defines the role of each module in terms of the ways it can be made to interact with other modules. First, it is necessary to define the distinction between signal and control inputs or outputs.

A signal is a voltage waveform with a periodic frequency between 20 and 15,000Hz. It is, thus, within the audible range and can be converted into sound with the proper amplifiers and speakers.

A control voltage is any alternating, direct, periodic, or non-periodic voltage. It may or may not be within the audible range. That feature making it a control voltage is that it is not converted into sound, but is used directly as a control for another module.

With these definitions given, it is possible to continue with their application to the various types of modules. A device having a control input may be controlled by another device with a control output. Note, however, that those devices having signal outputs only, such as the white-sound source, may still be employed as control-voltage sources. The distinction means that the output of these devices will always be in the audible range.



Block diagram of typical sound synthesising or modifying system.

A device having control outputs only produces no signals in the audible range and may be used only to control other devices (as in the case of the keyboard). Devices having both signal inputs and signal outputs are inserted into the signal path for modification, applications, such as amplitude, modulation, filtering, envelope control, and so on, and they require an input before any output signal will be available. Note that in no case does any module have only inputs, as this would be an absurd situation.

The following basic rules should be followed in interconnecting the synthesiser:

1. Signal inputs may receive only signal outputs.
2. Control outputs may drive only control inputs.
3. Control inputs may receive both signal and control outputs.
4. Signal outputs may drive both signal and control inputs.

In addition to the above rules, it is necessary to establish a complete signal-flow through the synthesiser from signal sources in the oscillators to the final output in the mixer to the monitor system.

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CLASSICAL RECORDINGS

Reviewed by Julian Russell

BRAHMS — Alto Rhapsody.
MAHLER — Five Songs.
WAGNER — Wesendonck Lieder. Christa Ludwig and the Philharmonia Orchestra and Chorus conducted by Otto Klemperer. EMI Stereo ASD2391.

When the Brahms and Wagner pieces performed by the same artists were first issued in 1963 they were coupled with the "Liebestod" from "Tristan and Isolda." In those days Christa Ludwig sang mezzo-soprano roles so that while the Brahms and Wesendonck lieder were fine, the "Liebestod" was not up to the same standard. Nowadays, as you probably know, she has trained her voice up and sings the roles of Isolda and even Brunnhilda, with some detriment, in my opinion, to the richness of her voice, especially to the lower register. But listeners would have to be hypercritical to find any but the most minor faults in her performances on this disc.

The Alto Rhapsody is sombre music written when Brahms suffered deep unrequited love pangs for Julie, the daughter of his friends, Robert and Clara Schumann. After Robert's death Brahms became a lifelong friend of Clara, though whether or not he wooed her with more success than he had done her daughter has long been a matter for speculation among music historians. At any rate he never married and died a grumpy old bachelor. The music of the Alto Rhapsody is dark coloured, tonally and emotionally, but of abiding beauty, the spirit of which, after a momentarily uncertain start, is caught to perfection by Ludwig. She is particularly impressive in the way she handles the unusually wide intervals that occur from time to time.

She and the orchestra come so close to perfection that it is a pity to hear the chorus, when it enters, recorded just a little too far behind the soloist. This and the fleeting unsteadiness mentioned above are the only blemishes on a performance of rare beauty. And even now, when it is no longer unexpected, I can still thrill to the plagal cadence of the majestic Amen to which the last words are set.

Only one of the Wesendonck lieder, "Traume," was scored by Wagner. All were originally written for voice and piano and the other four orchestrated by a famous conductor of the time, Felix Mottl. All were studies for "Tristan and Isolda" and the heavily perfumed chromaticism of that erotic masterpiece pervades them all. These, too, are beautifully performed with only trifling faults to encourage churlish criticism. By the way, theer are many important inaccuracies in the annotations where they tell of Wagner's tangled love-life at the time he wrote the songs. To those interested in a true account of the master, his loves, and especially his hates, I recommend Robert W. Gutman's "Richard Wagner," published by Secker and Warburg last year. Those who think they already know a great deal about the character of the great composer might well find much to surprise them in this new biography. But to return to the songs. Is it the memory of Ludwig's marvellous Brangane that makes "Traume" sound the best of the five? It might well be.

The five Mahler lieder comprise two from "Des Knaben Wunderhorn," "Earthly Life," and "Where the Proud Trumpets Blow," with texts by the composer, and three with texts by Ruckert, "I Have Lost Track of the World," "At Midnight," and "I Breathed a Gentle Fragrance." All are lovely, but I make special mention of the effect of black nightmare in the scoring of "At Midnight," for wind only with harp and timpani, and, two songs later, the marvellous fragility of "I Breathed . . ." A consistently beautiful and often thrilling disc.

* * *

RESPIGHI — The Pines of Rome. The Birds. The Fountains of Rome. London Symphony Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6401.

Respighi's "Fountains of Rome" and "Pines of Rome" had a great vogue until about the time World War II started. Since then, although frequently recorded, they are seldom heard in Australian concert halls. They are brilliantly orchestrated, richly harmonised, basically melodious and, of course, as romantic as all get out. I found both quite surprisingly good to listen to after a long interval. By the way it might be worthy of mention that the "Fountains" was responsible for one of my biggest disappointments when I visited Rome in 1965. The "Triton Fountain in the Morning," the second item in the Respighi suite, starts with an immense gush of sound so that I went to look at the fountain, thinking I would find some enormous cascade.

Instead all I found was one thin jet blown into the air. The "Pines" was written some seven years after the "Fountains" and is even more voluptuously orchestrated. There is also much more harmonic freedom. The "Pines" pays allegiance to many other composers. There are more than occasional hints of Stravinsky (Petrouchka), and Moussorgsky was almost certainly in Respighi's mind when he composed "The Pines near a Catacomb." Other influences are too numerous to mention though you might have some fun spotting them, and to my mind they do the music no real harm. Purists have always criticised the use of recorded nightingale's song in the "Janiculum" movement. I find it most effective every time I hear it.

The last movement evokes quite marvellously the steady, relentless mile-consuming stride of ghostly Roman legions marching along the pine-lined Appian Way.

The Birds I heard for the first time on this disc and found it an enchanting experience. The short pieces are arrangements of delicious trivia by Pasquini, de Gallot and Rameau and are so appetising that they might well charm all the birds of Rome off both the Fountains and the Pines of that city. The playing and recording are in top class.

* * *

CHARPENTIER — Midnight Mass for Christmas Eve.
PURCELL—Te Deum. World Record Club, stereo S/4651.

Since the early days of harmonic music, the Mass has often been based on popular songs as a basis for the choral writing. Because some of these songs had ribald origins the Church not unexpectedly frowned on the practice. It is not unusual to come across Masses today that aim at a popularisation of the liturgical text. One has only to recall the various attempts to introduce a jazz-based Mass; and South American Masses using a contemporary popular idiom are far from uncommon. In his Midnight Mass for Christmas Eve, Marc-Antoine Charpentier (1634-1704) used a series of Christmas carols well known during his lifetime. His idea, as pointed out in Charles Cudworth's sleeve notes, "was to choose his carols with great care, not only for their musical value but also for their allegorical and liturgical significance. (They) would have appealed to the humblest and simplest member of the congregation for the tunes were well known and not difficult to recognise although sung to the Latin words of the Mass." The Mass offered here as "realised" by Antoine Geoffroy-Dechaume, is a work of fragrant, delicate charm in every movement from the opening, sprightly Kyrie to the innocent mystery of the Agnus Dei. The mellifluous sound produced by the choristers of the King's College Chapel differs radically from that hard-edged tone used by French choirs, though the English group can when necessary, as in the Gloria, make a splendidly vigorous attack on the material. The accompaniment is scored with the greatest possible refinement for a small combination of instruments and admirably played by the English Chamber Orchestra. The whole work and its performance are perfectly attuned to the simple eloquence of the Nativity legend.

Purcell's Te Deum is a sturdier piece altogether, though French influence on its composer can be recognised without difficulty. It is in the form of a large-

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scale anthem, a typically English treatment. Jubilation is its theme, and this is admirably achieved by every one concerned in the production. Personally I dislike the kind of tone produced by counter-tenors but that does not prevent my appreciating the artistry of James Bowman in the alto part of this disc, though, alas, I cannot grow to like it. I am aware that many will disagree with me on that point and for them the only blot on my enjoyment of the performance will be removed.

★ ★ ★

COUPERIN — Apotheose de Lully. CHARPENTIER — Suite from the Opera Medee. English Chamber Orchestra conducted by Raymond Leppard. World Record, stereo S/4609.

On this disc, Charpentier offers an entrancing selection of dances and preludes from his opera Medee. Most of them are happy but there is a fine brooding movement, the "Prelude for Medee Alone," a deeply introspective soliloquoy. The whole production makes it clear that in Charpentier the French of the period had a composer with a fine sense of the dramatic, though back in the days he lived, Lully ruled the musical side of Louis XIV's court so despotically that Charpentier would have had little opportunity to display his skill in this form.

Couperin le Grand was luckier than Charpentier in having been born a generation later, when Lully's musical dictatorship was a thing of the past. To Couperin's contemporaries Lully was a figure for adoration, since they had escaped his jealous exclusion of all composers of merit during his term as musical overlord of Louis XIV's court. At the safe distance of 30 years after Lully's death, Couperin could express without any afterthoughts of criticism his adoration of the older composer. The suite, the Apotheosis of Lully, is in innocent program form, setting Lully down among the shady trees of the Champs Elysees, at that time a bosky retreat for Parisians and not the famous avenue it is today.

All the music contradicts the theory held by many today that Couperin's music is sterile and dry. Those who care to listen to that offered on this disc will find him rich in melodic invention and effective in painting graphic, albeit simple, programmatic pictures. Stylistically Raymond Leppard presents the music faultlessly and his transcription of the original pages, for the most part left unmarked as to instrumentation, is a continuing delight.

★ ★ ★

VIVE LA FRANCE! Six Favourite French Showpieces. Orchestre de Paris conducted by Jean-Pierre Jacquillat. EMI Studio 2 Stereo TW0264.

A novelty on this disc is Berlioz' stirring arrangement for orchestra and chorus of the French national anthem, "La Marseillaise." His treatment of the subject brings to mind the Elgar choral and orchestral arrangement of "God Save the King," though all comparison between our own rather doleful anthem and the exciting martial strains of the French one ends there. As might be expected "La Marseillaise" is presented here with great elan, calculated to make the most reserved Frenchman shake hands and blow their noses noisily.

It is a pity that Dukas' music suffers from almost total neglect nowadays. "La Peri" and his opera "Ariadne et Barbe Bleu" could well stand revival. He was one of the most elegant composers of his generation, one marked by the highest refinement. When Dukas knew he was dying he destroyed all but a few of his manuscripts, so great was his capacity for self-criticism. "L'Apprenti Sorcier" has perhaps had the strongest staying power of anything he wrote but I cannot confess to any real enjoyment of it as presented here in abridged form. It is a plodding performance, without sparkle, and could have been conducted by a German. I am aware that this comparison is anything but complimentary, but that's the way I feel about it.

Saint-Saens' "Danse Macabre" has nice rhythm and a seemly amount of Palm Court sentimentality in its solo violin part played with a wide tremolo. Personally I have always thought this composition vapid and trivial. I much prefer the crystalline elegance of "La Rouet d'Omphale." I wonder if anyone today remembers the vocal version of "Danse Macabre" sung by the Rusian tenor, Vladimir Rosing, on a 10in 78rpm disc many, many years ago with the words "zig a zig a zig" that gave it a faintly naughty air? The version under review is much more serious and should appeal to those who can respond to its naive program.

Lalo's "Scherzo" is an eminently pleasing work, cleanly but colourfully scored in a manner that would certainly have won the approval of Rimsky-Korsakoff. It is given a wholly attractive performance, as is Chabrier's "Espana Rhapsody." But the best playing on the whole disc is reserved for Debussy's "L'Apres-midi d'un Faune," scented, languorous but never too juicy, I still prefer the Monteux recording, but the Paris Orchestra make of it a valuable contribution to a record that might well have a wide appeal, even outside France. The "Studio 2" sound, with its very wide range of dynamics and its spotlighting of orchestral soloists, is used with gratifying discretion.

★ ★ ★

BERLIOZ. — Symphonie Fantastique. New Philharmonia Orchestra conducted by Leopold Stokowski. Decca Phase 4 stereo PFS4160.

Purists will find some of Stokowski's interpretative exaggerations unpardonable. He even goes to the length of making slight changes, here and there, in the incomparable score. But these, in retrospect, somehow seem of little importance when incorporated into the general impact of the reading, which is as tremendous as it was, to me, unexpected. Nor is Stokowski's reading the only factor to supply this wallop: the Phase 4 recording which surrounds the listener in a warm bath of sound makes its own additional contribution. Berlioz himself might conceivably have approved of the highlighting of solo instruments that often occurs especially as, in addition to this italicising, there are some effects of the utmost fragility.

Whatever your attitude, this per-

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formance has a quite exhilarating freshness, and commitment, though the latter may be Stokowski's very own, rather than yours.

The Phase 4 system is aimed at audiences looking for forceful demonstration of hi-fi reproduction rather than the more subtle considerations of balance and textual immaculacy, and it is the former that you will find on this extraordinary recording of a well-known symphony. Strangely, while you do not always get Berlioz' French purity of line, you are spared frenzied climaxes that you might have been excused to expect from Stokowski in a work that offers so many temptations to even the most sedate of conductors. Indeed it is in just such passages that Stokowski astonishes by his restraint. Recommended on the grounds of a quite novel experience.

* * *

THE VIRGINALISTS. — Pieces for Harpsichord and Positive Organ by Farnaby, John Bull, Byrd, Tomkins and others, played by Lionel Rogg. Record Society Stereo S/6324.

The title of this disc is misleading. I had expected to hear the pieces named played on a virginal, an instrument of deliciously fragile tone. Instead they are played on a very hard-toned harpsichord. But this surprise behind you, you can settle down to enjoy 19 little pieces without a dud among them. A few are played by Rogg on a sixteenth-century positive organ which emits the sweetest imaginable sound. Rogg's harpsichord technique is nice and crisp and though I am no authority of the style of the period (about which, by the way, much contradictory material has been published), they sound fine to me. The record was originally published under the Harmonia Mundi label and is splendidly recorded except for some slight occasional intrusion from the instrument's mechanism.

* * *

GRIEG — Peer Gynt, 12 Items. Halle Orchestra conducted by Sir John Barbirolli. E.M.I. Studio 2 stereo. TW0269.

"Studio 2" employs a similar recording technique to "Phase 4" and is aimed at a similar audience. "Peer Gynt" was therefore an obvious choice of the producers for such a market. Those who know the famous suite by only the abridged version will be unfamiliar with the additional items included here. Grieg wrote in all 23 pieces of incidental music for the play of which Barbirolli plays 12 in this completely enjoyable recital. The Studio 2 process is used discreetly giving the listener ultra hi-fi without tasteless exaggerations. Barbirolli plays all the music with great affection which he successfully transmits to his orchestra.

The fact that the words are in German in the very few vocal items may disturb some people. I found them off-putting in the old Beecham disc, but less so here, perhaps because the singers have been less prominently recorded and their diction is less clear. I would have preferred the "Death of Ase" to have been a little more consistently quiet. But this is only a very minor quibble when the playing elsewhere is so really glorious.

JOHN OGDON PLAYS POPULAR LISZT. EMI Stereo OASD2 416.

John Ogdon has a seemingly endless series of personalities. His Bartok is as fine as his Beethoven, his Messiaen as satisfying as his Bach. For this recital he has chosen pieces to display the many facets of his generous gifts. Thus you have big works — "Funerailles," the second "Paganini Etude," and the "Polonaise" No. 2 in E, as well as more intimate things, such as the A Flat "Liebestraume," "Un Sospiro" and the "Valse Oubliee." Ogdon has a tremendous technique, even in these days when such equipment is more or less taken for granted. He plays his Liszt with much the same bravura that, one has read, distinguished the composer's own performances. To technical brilliance he manages to add a great variety of different sonorities, achieving at times an almost orchestral effect. And in control of these virtues is a mind always deeply penetrating of the composer's intentions. You'll look around in vain for better Liszt playing than you hear here. You may find an occasional detail with which you disagree, but the general effect is terrific.

* * *

MENDELSSOHN — Octet in E Flat. WOLF — Italian Serenade in G. ROSSINI — Sonate a Quattro No. 3 in C. I Musici. Philips stereo SAL3640.

Two of the compositions featured on this record were written by boys. Mendelssohn had finished his Octet before his 17th birthday; Rossini's Sonata a Quattro No. 3 was ready for performance before he was 13. Yet neither could be classified as a school exercise. Both show signs of amazing maturity. While one still marvels at Mendelssohn's freshness of invention, already showing marked individuality, still more wonderful is the precocious skill of the writing. The scoring is for double string quartet, the instruments not merely doubling each other but each playing, most of the time, one of eight separate parts.

If, in the first movement, the bass sounds a little congested, Mendelssohn improved as he went along for by the time he reached the third movement, a Scherzo, its aerial qualities foreshadow still another miracle by the young composer, the Overture to the incidental music to "A Midsummer Night's Dream." The Andante which separates the two movements is also better spread in the bass than the introductory Allegro Moderato. I Musici play the whole work admirably, but I must specially mention the Scherzo, where these gifted Italians never fall into the trap of over-accentuation. A fresh complexioned, deft performance of a work that seems to have imperishable charm.

I did not listen to Wolf's "Italian Serenade" with quite so much enjoyment. Here I Musici's playing of the version for string orchestra sounds ever so slightly heavy and over-expressed. I much prefer the work in its original form for string quartet, played with bouncing affection back in the 1930s by one of the famous quartets of the day — I cannot recall its identity — on a 10in 78. In comparison to this spritely performance, I Musici make theirs sound rather a chore, lacking spontaneity and the spirit of insouciance unusual in this self-consciously serious composer.

I suppose a boy of Rossini's age was bound, in 1804, to have been influenced by Mozart and Handel. After all, what better influences could he have had? Despite this, an astonishing amount of the composer's own personality overrides these allegiances. The technical and imaginative resources of the Finale—a set of variations—are beyond belief. I Musici's performance preserves all the work's innocence and the recording of the whole disc is immaculate.

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VARIETY FARE

By HARRY TYRER, FORBES CAMERON, NEVILLE WILLIAMS

Devotional recordings

SMASH AND GRAB WORLD. Music and Poetry by Tedd Smith. Vocals by Joan Hettenhouser. Compatible stereo, Word WST-8479-LP. (Available from Sacred Productions Aust., 181 Clarence Street, Sydney and other capitals).

Interest: The dilemma of youth.
Performance: Very high standard.
Quality: Excellent.
Stereo: Normal.

This new Word album reveals another side of well-known Billy Graham campaign pianist, Tedd Smith. In monologue, song and music, he has tried to express the problems of modern youth, as he has observed them around the world. Track 1, "Jump for Joy" is a happy, carefree, mixed-up sound, with piano, guitars and vocal. Track 2, "Games" expresses the futility of so much formal religion: Clear my conscience but get it over with! But then, the alternative, this "Smash And Grab World" isn't very satisfying either. What so many kids really want is "A Little Understanding."

On side 2 "Circles" has a "stop the world, I want to get off" theme. But "The Runnin' Man" suggests that it's about all there is for some kids; how much better a bit of real love would have been than the too-frequent "here's some money — get lost!" "Outside" expresses the problem of outsiders getting "inside" the Gospel theme. The final track "The Good I Would Be" is the good-in-me-bad-in-me conflict dramatised in music, with good-in-me gradually becoming dominant.

This new album reveals Tedd Smith's capabilities as a writer and composer, while also providing plenty of scope for his expertise at the keyboard. The guitar work and the vocals are also right out of the top drawer. An interesting record for anyone with a youth/Gospel interest and certainly one which would be a conversation piece in youth meetings. (W.N.W.)

* * *

REJOICE AND BE GLAD. The Scottish Festivals Of Male Voice Praise. Directed by James McRoberts. Stereo, Word WST-9032-LP. (Available from Socred Productions Aust., 181 Clarence Street, Sydney and other capitals.)

Interest: Well-known male choir.
Performance: Smooth, finely disciplined.
Quality: Normal.
Stereo: Adequate spread.

The movement known as The Festivals of Male Voice Praise was founded in 1934 by James McRoberts. At the time this album was recorded, under the direction of the founder, the movement boasted a membership throughout the British Isles of around 3,000 men.

The hundred voices recorded here are extremely well disciplined, but there is a sense of conviction and purpose about it all. Diction is good; good enough, in fact, to pick the accent from the Banks of the Clyde!

With only occasional support from a distant piano, the choir presents a 32-minute program of mostly well-known hymns: All That Thrills My Soul — Worthy The Lamb — On Christ The Solid Rock — My Redeemer Lives — Burdens Are Lifted At Calvary — Rejoice And Be Glad — Do Not Fear The Bend In The Road — 'Tis Marvellous and Wonderful — Fierce And Wild The Storm — He's The Lily Of The Valley — We'll All Be There.

The words are printed in full on the rear of the jacket giving listeners the opportunity to sing along if they so desire. An album that will certainly appeal to those who like male choirs. (W.N.W.)

* * *

MY CHILD. Dawn Goodfellow. Stereo, Focus FS-1001. (Distributed through RCA).

Interest: Local Gospel soloist.
Performance: Sincere, capable.
Quality: Excellent.
Stereo: Normal spread.

Dawn Goodfellow, then Dawn Smith, was introduced to the Australian radio scene at the age of 17, as a soloist for the Christian Broadcasting Association, being featured on the "National Sunshine Hour" and "Hymns We Sing." Since then, she has featured regularly in Sydney, Melbourne and rural cities on Baptist Youth Crusade Rallies, Youth For Christ, Christian Television Association, National Christian Endeavour and major Gospel Crusades.

With all this experience behind her, and backed by a professional group directed by Ray Myers, Dawn gives the kind of performance one would expect, warm, sincere and capable. Her pitch and voice control are excellent, her diction particularly clear. In fact, if I had any criticism, it would be that her diction is just a little too studied for the intimacy of a modern stereo recording. She should aim for a slightly more round, more mature sound on record.

The 31-minute program includes eleven Gospel songs: The Answer's On The Way — So Many Million Years — Wouldn't Take Nothing — It's Different Now — Somebody's Knocking At Your Door — My Child — He Bought My Soul—Were You There?—Go Tell It On The Mountain — Have You Met Jesus? — Steal Away.

The backing under the direction of Ray Myers is in a modern, pleasant style, and I am certain that Dawn Goodfellow's many admirers throughout Australia will welcome and enjoy this new album. (W.N.W.)

* * *

SING ROUND THE YEAR. Donald Swann. Stereo/mono compatible, Move MS-3002. (Available from selected distributors or from Move Records, 156 Collins Street, Melbourne, 3000, Australia).

Interest: Modern devotional music.
Performance: Refreshing.
Quality: Forward, clean.
Stereo: Nicely spread.

Australian viewers and listeners will doubtless remember Donald Swann as the pianist in the enjoyable Flanders and Swann stage presentation "At The Drop Of A Hat." He emerges in this album as the moving force behind a program of refreshingly new devotional music, some composed by himself, some by Sydney Carter.

Swann's talents at the piano are well to the fore, but he also does several of the solos in a voice that gains in clarity and conviction what it lacks in quality.

Recorded in St.Mark's Church, in the West End of London, the album also makes generous use of a boys' choir from the Westminster School and a girls' choir from the Mayfield School, Putney. Organist is Nicolas Jackson, and conductor Sylvia Junge.

The jacket is endorsed "18 Carols" but the notes hasten to point out that the term carol is not confined in its meaning to the Christmas setting. It can cover a variety of musical forms and, in the general sense, be applied to any happy song which celebrates a Christian event.

And variety there certainly is. In some of the songs, there is an element of protest: While the Christians celebrate Christmas inside, the stranger outside is rebuked for knocking at the window. The hypocritical concern of Judas for the poor is contrasted against the devotion of Mary. In other songs, the two choirs join in happy celebration and there is an anthem-style presentation, with full voice and massive organ support. With unfamiliar — but easily assimilated — items like this, there would be no point in listing the titles.

This is modern devotional music but modern in the context of young people in an English church situation — not on a Gospel rally stage or in Nashville-like studios. I found it interesting and refreshing. (W.N.W.)

* * *

SACRED MUSIC. Jean-Christian Michel. Festival stereo SFL-933,-443. Available in mono.

Interest: I wish I knew.
Performance: Unconvincing.
Quality: Mediocre.
Stereo: Normal.

I do not know what Jean-Christian Michel is trying to prove, but whatever it is, he has not convinced me. The first and last items in this recital are Bach pieces, and looking at the line-up, featuring clarinet played by Michel himself, grand organ (Monique Thus), Percussion (Kenny Clarke), Double bass (Willy Lockwood) and clavecin (Chantal Vovard), one might think that the aim was to present something of the style of the Play Bach group. If this is the case, they missed the mark. The remaining items have apparently been composed by Michel, but they are so closely modeled to the style of Bach that they have about as much artistry as a black and white photograph of a Goya painting. The outline is there, but the genius is missing.

If, on the other hand, Michel is simply experimenting to evolve a new style of music for the church liturgy, well and good, but what may be acceptable as music on an amateur level in a church is certainly not acceptable on an LP disc. M. Michel's clarinet playing is very bad. His technique is poor, and his tone is rough and strident. One is therefore not surprised to learn from the sleeve note that he is a doctor of medicine, and therefore an amateur musician. The other artists do their best with the material and play very competently, but what a waste of that great drummer Kenny Clarke (previously with the Modern Jazz Quartet) in the limited scope he is provided with here.

For the record, the tracks are: Trio — Psaume — Invention in G minor — Angelus — Apocalypse — Aqua Sancta — Petite Fugue — Chorale: Spiritus Alter — Prelude. (H.A.T.)

Instrumental, Vocal and Humour . . .

MUSIC OF RAVEL. Orchestre de Paris, conducted by Charles Munch. His Master's Voice (E.M.I.) stereo OASD 2497.

Interest: French classics.
Performance: Virtual perfection.
Quality: Excellent.
Stereo: Well spread.

Almost inevitably in a disc of this type, the program starts with the "Bolero." The performance here is exactly to my taste, played slowly and sinuously, the soloists making the melody sway most enticingly, Munch builds up to the climax most skilfully, so that it arrives at exactly the right moment. Many conductors get there much too soon, so that the orchestra is thundering flat out for about five minutes — an effect I find quite ludicrous. The recording goes to the top of the list of my favourite versions of the Bolero.

The Pavane and Spanish Rhapsody are equally successful, but for most people I imagine the major interest will be in the Daphnis and Chloe music. This is exquisitely played, and right from the sweeping clarinet arpeggios at the start to the final chords one is swept along by the beauties of the score. A disc which I can only describe as virtually faultless, as the engineering is also of excellent standard. (H.A.T.)

★ ★ ★

HAPPY BIRTHDAY, SIR JOHN. Issued to commemorate the 70th birthday of Sir John Barbirolli. His Master's Voice (E.M.I.) stereo OASD 2496.

Interest: See above.
Performance: Graceful and relaxed.
Quality: excellent.
Stereo: Normal.

At first glance, the rather insubstantial collection of music presented here might seem rather on the light side as a birthday tribute of a musician of Barbirolli's standing. In fact, there is a definite thread tying them all together — they are all arranged either by Sir John or his wife, Evelyn Rothwell, who is also the soloist in two works (she is an accomplished oboe player). It is, incidentally, mainly eighteenth century music, lightweight and graceful, and entirely suitable for relaxed evening listening.

The program comprises: Suite for Strings (Purcell)—Oboe Concerto in F major (Corelli) — Sheep May Safely Graze (Bach) — Oboe Concerto in C minor (Marcello) — An Elizabethan Suite. There are some interesting points about the above which are worthy of comment. The Corelli concerto was not written as such, but was assembled by Sir John from the works of violin sonatas for his wife. The Marcello work was arranged by Evelyn Rothwell herself, but it had previously been adapted by Bach as a harpsichord concerto, and the Bach ornamentation is preserved in this arrangement. The "Elizabethan Suite" is actually a collection of short items by leading British composers of the Elizabethan era, arranged for full symphony orchestra by Sir John. Pedants have been known to complain about this treatment of works originally written for the delicate keyboard instruments of the seventeenth century, but the response to the work at concerts shows that the musical public has little respect for this point of view.

The B.B.C. Symphony Orchestra features in the Suite, and the New Philharmonia in the Corelli concerto. Sir John's own Halle Orchestra plays all the other works. I could find nothing to complain about in the performances. The recording quality is excellent also. (H.A.T.)

★ ★ ★

CLASSICAL MINIATURES No. 2. Franck Pourcel and his orchestra. Stereo. Columbia Series 250, SOEX-9495.

Interest: As per title.
Performance: High standard.
Quality: Very clean.
Stereo: Nicely spread.

Those who like their classics and near-classics in small, tuneful servings will certainly enjoy this presentation by Franck Pourcel. The items are tuneful, familiar and well played. Perhaps it is appropriate to mention that, while the word "miniature" may serve as a title, it certainly does not describe the orchestra, which is generous in both size and musicianship.

The tracks, playing for a total of about 40 minutes include: Warsaw Concerto (Addinsell) — Serenade (Schubert) — Faust, Waltz from Act II (Gounod) — Waltz Op. 39 (Brahms) — La Vida Breve, Spanish Dance (Falla) — Werther, Clair De Lune (Massenet) — Perpetual Motion (Paganini) — Valse Triste Op. 44 (Sibelius) — La Danza (Rossini) — Ave Maria (Schubert).

Recommended, if you are partial to records of this type. (W.N.W.).

★ ★ ★

A LIGHT CLASSICAL PROGRAM. Various orchestras. Elite (Festival). Stereo SFL-933,251. Available in mono.

Interest: As per title.
Performance: Pleasing.
Quality: Adequate.
Stereo: Normal.

The 12 tracks on this disc all appear to have been selected from discs of light classics in the Swiss Elite company's catalogue, so it is virtually a sampler. Various orchestral groups are featured, including the Vienna Opera Orchestra, the Viennese Promenade Orchestra, Vienna Sound Artists Orchestra, and Fred Mataschky and his Light Music Ensemble. These are all very well trained groups, whose playing standard is more than adequate for the light type of music presented here: Flight of the Bumble Bee — Csardas from "Coppelia" — Romance — Russian — Petite Waltz — Warsaw Concerto — The Trumpeter of Sackingen — Intermezzo from "The Jewels of the Madonna" — Hungarian — La Ronde — Prelude to Act 1, from "La Traviata" — Sabre Dance. Some of these are too well known to require comment. The others are conversely, unfamiliar, and I can give no assistance as to their origins, as there is no sleeve note. However, they are all eminently tuneful and listenable.

In conclusion, then, this is a pleasing enough selection, nicely played, but one questions the $5.75 price tag for this type of disc. On Festival's Calendar label, at $2.95, this would be a much more attractive proposition. (H.A.T.).

A POPS SERENADE. The Boston Pops Orchestra, conducted by Arthur Fiedler. RCA Dynagroove Stereo LSC-3023.

Interest: Palm Court melodies.
Performance: Fine.
Quality: Excellent.
Stereo: Good spread.

Surely the king of orchestras where light music is concerned, the Boston Pops gives us here one of their famous Pops Serenades programs, featuring famous melodies which should be known to every person with an interest in light classical music: Serenade (Schubert)—Serenade (Drigo)—Spring Song (Mendelssohn) — Country Gardens (Grainger) — Minuet (Boccherini) — Intermezzo from "Goyescas" (Granados) — Drink to Me Only with Thine Eyes — Tambourin Chinois (Kreisler) — None But the Lonely Heart (Tchaikovsky) — Serenade (Toselli) — Intermezzo from "Cavalleria Rusticana" (Mascagni) — Dreams (Wagner) — Waltz (Volkman).

Everything about the disc is top rank. The orchestra, of course, has the same personnel as the famous Boston Symphony Orchestra; the arrangements are all one could wish; and the engineering is of the highest standards. Some points of the interpretations are perhaps open to question — for example, I like the Goyescas piece to be played rather more delicately — but such matters are largely subjective. It is a good program, thoroughly enjoyable, and I rate this as one of the few discs of light classics worthy of a full price label. (H.A.T.).

★ ★ ★

I LOVE PARIS. Aimable and his Orchestra. Vogue Records (Festival). Stereo SVL-933,542. Available in mono.

Interest: Popular French melodies.
Performance: First-class artistry.
Quality: Very good.
Stereo: Normal.

Monsieur Aimable is one of France's leading accordion players, with numerous international tours and a string of records to his credit. He is a versatile artist, and plays frequently in latin and jazz styles, but here he presents his "musette" style, featuring gently swaying melodies of the evergreen type. Aimable infuses into his performance a happiness and sparkle which should have wide appeal. The tracks included are: I Love Paris — La Ronde — Petite Lucienne — Pigalle — Speak to Me of Love — Under Paris Skies — La Sourire de la Seine — Plaisir D'Armour — Mademoiselle de Paris — Midi-Midinette — La Seine — La Mer — Petite Waltz — J'Attendrai. A pleasing program, beautifully played, which should have special interest to those who have nostalgic memories of a visit to France, and particularly Paris. (H.A.T.)

★ ★ ★

STRICTLY OOMPAH. Willy Glahe and his Orchestra. Decca (E.M.I.), Stereo PFS 4166.

Interest: Popular German melodies.
Performance: Splendid playing.
Quality: Excellent.
Stereo: Well spread.

One can be misled by cover artwork at times. Seeing the picture of a corpulent German gentleman attired in folk costume, playing a sousaphone, adorning the cover of this disc, I as-

sumed the worst, and expected to have to endure listening to a group of amateur bandsmen "oompahing" their way through the dozen tunes listed. As it turned out, I was treated to some splendid playing by a full professional orchestra. It is not a brass band, as one might be lead to believe by the title, but it does have a large brass section, which is fully employed in these arrangements. The tunes are those lilting or stirring numbers which Germans like to hear played on festive occasions, such as: Radetzcy March — Kuckuckswalzer — Wiener Praterleben — Ich Hab' Mein Herz in Heidelberg Verloren — Der Treuer Husar, and others (12 tracks in all). The disc has been expertly recorded, with good stereo spread and definition. (H.A.T.)

★ ★ ★

THE BRASS MENAGERIE, Volume 2 Project 3 (Festival), Stereo SPJL-933,548. Available in mono.

Interest: Arrangements for brass.
Performance: Energetic.
Quality: Excellent.
Stereo: Well defined.

I suppose it would be an over-simplification to say there are two kinds of people — those who like brass choirs, and those who don't. Nevertheless, there is an element of truth in this, and one has to be careful in assessing this kind of performance not to put off those who would enjoy it while not tempting those who would not. If you are a brass man, you should be able to make up your mind if I recite the instruments used and the tunes played: there are four each of trumpets, trombones and French horns, playing four-part harmony, reinforced by a tuba, electric bass, flutes, piccolos and a percussion and rhythm section. These are powerful forces, and they make a lot of noise, in their renderings of the following: Aquarius — Hair — For Once in My Life — Happy Heart — Slow Bus to Oswego — Stars and Stripes '69 — Gentle on My Mind — Galveston — Zazueira — You've Made Me So Very Happy — Goodbye Columbus — Good Morning Starshine.

One could certainly not find fault with either the standard of playing, which is excellent, or the sound quality, which is of the highest standard. If you still have any doubts, ask your retailer to play you a track or two. (H.A.T.)

★ ★ ★

BOSSA NOVA 70. Lyrio Panically and his orchestra. Music for Pleasure stereo MFP A 8106.

Interest: Latin American.
Performance: Routine.
Quality: Good standard.
Stereo: Normal.

Bossa Nova fans (and there are still quite a few, although the enthusiasm which swept through the musical scene some ten years ago has subsided) will find plenty to enjoy in this selection of some of the very well-known tunes which have appeared over the years — tunes such as Para Que Llorar — Januaria — Barquito — Abuelita — Manana — Te Voy a Contar — Samba para Pedro — Estamos en Paz — La Respuesta — Mar and Mar — Y Nada Mas. I can't say much about Lyrio Panically and his orchestra, they are unknown to me, and the sleeve note doesn't give any information. However, they play very competently — but that's all. They do not appear to me to be in the top bracket. Good value at the MFP price, but don't expect to get $5 plus performance. (H.A.T.)

★ ★ ★

EQUINOX. Sergio Mendes and Brasil '66. Universal Record Club stereo SU-1026.

Interest: Bossa Nova.
Performance: Coolly assured.
Quality: Excellent.
Stereo: Good spread.

This release by Universal Record Club of a disc which was issued for the first time only last year represents another opportunity for Club members. The Brasil '66 group has been going great guns since its formation, and this disc is pretty typical of the type of gentle Bossa Nova material they offer. While Mendes makes a major contribution with his elegant piano work, there is no doubt that Lani Hall (the blonde one of the two female vocalists), holds the group together with her delectably cool singing, as is amply demonstrated here. Track titles in this selection are: Constant Rain — Cinammon and Clove — Watch What Happens — For Me — Bim-Bom — Night and Day — Triste — Gente — Wave — So Danco Samba. Bossa Nova fans will find this a pleasant experience. Sound quality is excellent, and stereo spread is good. (H.A.T.)

★ ★ ★

TRUMPET IN CLASSIC STYLE. Fritz Weichbrodt, trumpet. Universal Record Club (original recording by Vogue Records, Germany) stereo U1035.

Interest: Classic tunes, modern style.
Performance: Wooden.
Quality: Excellent.
Stereo: Good spread.

This disc is wrongly named — it is actually trumpet in popular style playing classical and traditional melodies. In addition to the soloist, there is a bass player, a percussionist and a mixed choir. The trumpeter moves slightly around the beat, but not enough to call it swing. His performance cannot be admired. His playing is quite expressionless, and his tone tends to be hard all through. However, the supporting artists perform admirably, particularly the soprano section of the choir, whose contribution alone made the disc bearable. The 12 tracks include: Prisoners' Chorus from "Nabucco" (Verdi)—The Carnival is Over — Theme from "Capriccio Italien" (Tchaikowsky)—Ave Maria (Bach-Gounod) — Theme from Act III Prelude of "La Traviata" (Verdi). The melody from Chopin's third study is presented as "Chopin's Dream."

Technically, the disc is well up to standard, with bright, clean sound, and good stereo separation. Conclusion: a disc for unsophisticated tastes. (H.A.T.)

★ ★ ★

BEETHOVEN PIANO SONATAS. Rudolf Firkusny. Music for Pleasure mono MFP-A-9028.

Interest: Piano classics.
Performance: Entirely satisfying.
Quality: Dated but good.

I have always admired the qualities of Firkusny's playing — the immaculate finger work, clarify of line, superb control of dynamics, and not least, his deep poetic insight. All these qualities are evident in this fine performance of

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CLASSIC RADIO

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the two most popular of Beethoven's piano sonatas: No. 14 in C sharp minor (Moonlight) — No. 8 in C minor (Pathetique). This then may be reckoned as a fine bargain at $1.99, particularly as the sound is quite remarkably good for the age of the recording (I believe it originates from the early days of LPs). Some people might complain that most LP discs give at least one more complete sonata, or equivalent fill, but the inclusion of only two has allowed the engineers to spread the grooves so that there is no trace of that bugbear of many modern piano recordings, pre-echo. The surface is very good too.

In his performance, Firkusny takes the first movement of the "Moonlight" rather faster than is the custom nowadays, but he pays meticulous attention to Beethoven's markings. For instance, he holds the pedal down almost continuously during the "Moonlight" first movement, and he heads straight into the last movement without a pause, at the end of the second movement. I thought the accompaniment figure in the slow movement of the "Pathetique" was a little too prominent early in the movement, but this quitens down later. If you have not yet acquired these works in your collection, this disc is certainly worth investigating. (H.A.T.)

* * *

HI-FLYING HAMMOND. Keith Beckingham at the Hammond organ. Stereo, Festival SFL-933,233. Also in mono FL-33,233.

Interest: Dancing, easy listening.
Performance: Smooth.
Quality: Clean.
Stereo: Hammond left, drums right.

As distinct from "Hammond Up Up And Away," also reviewed in this issue, Keith Beckingham plays for a ballroom rather than a concert audience. To this end Glyn Thomas lays down a strict tempo rhythm with drums and percussion, leaving the organ to provide the melody line. Within the necessary limitations of this format. Keith Beckingham gives a very good account of himself and provides a sound which qualifies easily for the description "easy listening."

The twelve tracks contain medleys involving some 29 numbers, some from the musicals, some from the movies but all of them middle-of-the-road favourites. For those who care to dance, there are waltzes, quicksteps, foxtrots, and Latin tempos.

As the label says: "For dancing and easy listening." (W.N.W.)

* * *

HAMMOND UP UP 'N AWAY. George Blackmore playing the X-66 Hammond Organ. Stereo, Festival SFL-933,237. Also in mono FL-33,237.

Interest: Hammond showcase.
Performance: Dynamic, skilful.
Quality: Mostly very good.
Stereo: Normal.

The jacket of this album is endorsed "Organ Showcase Series" and it is neither an exaggeration nor a misnomer. While some of the tone structures of this X-66 "theatre" model are characteristically and undeniably Hammond, George Blackmore never runs the risk of tonal monotony. At his fingertips he has the ability to manipulate attack, sustain and reverberation to produce sounds reminiscent of harpsichord and piano through to merimba and harp with celeste and banjo thrown in; these effects separately or added as colour to sustained tones.

And George Blackmore exhibits rare skill in using the many facilities, sometimes solo, sometimes backed with rhythm that has one trying to pick as live, electronic or a combination of both.

The program, occupying something like 33 minutes runs the gamut from Latin rhythms to a ponderous "Elephant Walk"; from swingin' jazz to romance, with even a touch of Bach and harpsichord. It is undoubtedly the kind of program that George Blackmore has evolved to maintain interest during his stage recitals.

It is an album that should find a wide, popular appeal, with an especial interest for electric organ fans. (W.N.W.)

* * *

NOW'S THE RIGHT TIME. George Wright at the Wurlitzer Pipe Organ. Stereo, Dot (Festival) SZL-933,534. Also in mono ZL-33,534.

Interest: Wurlitzer in different role.
Performance: Fine work all round.
Quality; First rate.
Stereo: Separation emphasised.

Having produced any number of Wurlitzer pipe organ solo albums during the years, George Wright here exploits the approach adopted by so many exponents of the electronic instrument — that of playing along with a small instrumental group. In so doing, he presents the theatre pipe organ in a completely new light — as a source of solo voices, widely varied in character and yet with a responsiveness that is surprising to say the least.

As displayed by the considerable talents of George Wright, the pipe instrument certainly does not suffer in this role in comparison with even the most elaborate of its electronic counterparts; and it certainly has the advantage when the fuller combinations are used. One other point, in the role of arranger and conductor, Jimmie Haskell lends a purpose and cohesion to the performance which is not hard to discern.

The titles: Time Is Tight — I've Gotta Be Me — Aquarius — Light My Fire — Galveston — Mannix — The Windmills Of Your Mind — Goodbye Columbus — My Way — Love Theme From Romeo and Juliet — Mission: Impossible — Zazviers.

Excellent in its own right, but Wurlitzer fans should certainly make a point of hearing it. Playing time is 31 minutes. (W.N.W.)

* * *

THE AGE OF ELECTRONICUS. Dick Hyman on the Moog Synthesiser. Command (E.M.I.) stereo SOSL 10067.

Interest: More popular Moog.
Performance: Lacks depth.
Quality: Excellent.
Stereo: Plenty of movement.

Multi-part performances such as those presented by Walter Carlos with his Moog synthesiser arrangements of Bach

and other baroque composers, require an awful lot of work and patience. Dick Hyman is apparently not prepared to give this kind of time and trouble to his arrangements of popular numbers. His technique with the synthesiser is to play the melody line only, hopping about from sound effect to sound effect, a bit of this, a bit of that. This obviously leaves something to be desired musically, so he adds a track of percussion, dubbed in afterwards. This might have an air of novelty, particularly when a few weird noises are thrown in here and there, but to my mind it misses the opportunity the synthesiser affords to skilfully build up a performance, with melody backed by harmony and counterpoint, closely integrated like a good orchestral arrangement.

In fairness to this disc, I should point out that several people who have heard it have liked it and found it amusing. Accordingly, I can only advise that you try to hear a bit of it before buying, to make up your own mind as to its merits. The titles are popular enough anyway: Ob-La-Di, Ob-La-Da — Give It Up Or Turn It Loose — Blackbird — Aquarius — Green Onions — Kolumbo — Time is Tight — Alfie — Both Sides Now. Sound quality is excellent throughout. (H.A.T.)

★ ★ ★

YARBROUGH COUNTRY. Glen Yarbrough, vocals, with the Jimmy Bowen Orchestra and Chorus. Warner Bros. (Australian Record Company) stereo WS 1817.

Interest: Modern C and W.
Performance: Pleasing.
Quality: Excellent.
Stereo: Normal.

One of the modern school of "intellectual" country and western singers, Glen Yarbrough is as much at home in the folk and ballad field. In fact, the dividing line, never entirely defined, becomes very light indeed in some of his performances. Thus, in this disc, one is not notably disturbed by the transition from Gordon Lightfoot's "Ribbon of Darkness" to Rod McKuen's "Jean;" or from Bryan Davies' "Wisconsin" to Bob Dylan's "Walkin' Down the Line." Other tracks in this entertaining disc are: Don't Let the Sun Shine Down on You — Sundown — Honey Drippin' Times — Abilene — Everybody's Talkin'. There is no doubt, however, about the style of the Jimmy Bowen Orchestra and Chorus, which provides excellent support all through — this is pure country and western style. C and W fans should find this disc to their taste. (H.A.T.)

★ ★ ★

THE GLORY OF WALES. The Morriston Orpheus Choir. World Record Club. Stereo S/4673.

Interest: Welsh choral music.
Performance: World class.
Quality: Good.
Stereo: Normal.

Back in 1935, a group of singing enthusiasts in the small Welsh town of Morriston got together with the object of forming their own male voice. After all, just about any Welsh town or village of any importance had a choir. That there was plenty of talent to draw upon was soon proved, when at its first attempt at the Welsh Eisteddfodd the choir carried off the first prize in its class. In the succeeding years, the choir

has gained an international reputation for fine singing. Most of the Welsh choirs no longer exist — the lure of television is too strong for the modern generation of Welshman — but the Morriston choir remains true to its traditions. Here, they present a program of some of the most popular Welsh traditional songs on side one, followed by five famous hymn tunes on side two: Arabella — All Through the Night — Men of Harlech — Innocence — Counting the Goats — The Ash Grove — Laudamus — The Golden Harp — Deus Salutis — St. Mary's Church — In the Sweet Bye and Bye.

This is fine singing, which should have universal appeal. I suspect the disc is now a few years old, to judge by the slightly dated sound quality, and the rather low level of recording. Nevertheless, it is clean sound, only lacking the immediacy which distinguishes the best modern recordings. (H.A.T.)

* * *

GOD BLESS THE PRINCE OF WALES. The Morriston Orpheus Choir, conductor Eurfryn John. Columbia (E.M.I.), Stereo SCXO 6338.

Interest: More Welsh choir.
Performance: Fine style.
Quality: Excellent.
Stereo: Effective.

Apparently recorded to honour the inauguration of the Prince of Wales last year (although originally recorded before the event) this disc provides another opportunity to hear the excellent singing of the Morriston group. With a choir of such reputation, one can take for granted the technical excellence and the fine tone, which are evident from the first track. The main interest is therefore in the contents.

Musically, the first track, "God Bless the Prince of Wales" has little to recommend it, but it was included here for the purpose already mentioned. Likewise, the second track, "Cymru'n Un," the words for which were written by Britain's World War One Prime Minister, Lloyd George, is unremarkable. The sleeve notes tells us that the words are "stirring and patriotic," but since they are in Welsh, and no text is included with the disc, they might just as well be a Welsh setting of "Mary Had a Little Lamb." Next is "Gwahoddiad," a setting of a Welsh hymn tune. Here again, the absence of an English translation does nothing to help one's appreciation, although the music is attractive enough. I feel the next two tracks ("Oh Isis and Osiris" from Mozart's "Magic Flute," and Sullivan's "Lost Chord") together with the last track on side 2 ("Easter Hymn" from "Cavalleria Rusticana") are the most interesting for the average listener. These are too well known to require comment.

The remaining items are: "One World," a song by Geoffrey O'Hara which is particularly appropriate in the unsettled international climate of today — "Comrades in Arms," a male chorus by Gustav Adam, composer of the ballet "Giselle" — "Arise O Sun," an erstwhile popular ballad — "The Martyrs of the Arena," a dramatic ballad which allows the choir full scope to show its abilities — "When Evening's Twilight," a part song by Hatton, of "Simon the Cellarer" fame. In summary, perhaps not the most inspiring of programs for the average listener, and one that suffers in interest from the lack of a text. (H.A.T.)

* * *

TWO LITTLE BOYS: I LOVE MY LOVE. Rolf Harris. Festival 7in 45rpm, mono FK-3438.

Interest: Rolf's latest hit.
Performance: Sentiment plus.
Quality: Good.

The lastest Rolf Harris hit "Two Little Boys" has been released as a single in Australia by Festival Records. One wonders how this song, which has the ultra-sentimentality of a Victorian music-hall tear-jerker, could ever find favour with today's sophisticated audiences, but it appears that this almost maudlin number is firmly headed for the top of the popularity charts. The backing number, "I Love My Love" is in complete contrast — a lusty driving number with a strong beat. I predict it will outlive its companion number, eventually. (H.A.T.)

Popular Jazz

AND HIS MOTHER CALLED HIM BILL — Duke Ellington and his Orchestra. Victor LSP 3906 (Stereo).

Interest: Tribute to Strayhorn.
Performance: One of Ellington's greatest records.
Quality: Superbly recorded.
Stereo: Excellent balance.

Three months after the death of Billy Strayhorn, in May, 1967, the Duke Ellington Orchestra recorded 12 of his compositions as a tribute to this great arranger and composer. In the process the Ellington Orchestra produced one of the most memorable sessions in their long history.

The more familiar Strayhorn compositions like "Take the A Train" and "Chelsea Bridge" were not included but one suspects that the 12 tracks on the album were some of Strayhorn's personal favourites.

The Orchestra at this time was, by Ellington standards, a very great one and the musicians themselves obviously felt the tragic circumstance of this recording session very deeply. They played with their heart for a man they all loved. It is, in a very real sense, meaningless to analyse this album track by track. It should be listened to as a complete tribute to Strayhorn.

But nevertheless, the individual highlights are many, including Johnny Hodges' solos on "Blood Count," the beautiful "Daydream" and "After All," Cat Anderson's feature on the "Intimacy of the Blues," Clark Terry on "Ummg" and the brief solos throughout by Cootie Williams, Lawrence Brown and Paul Gonsalves. Perhaps the most touching track of all is the Ellington piano solo "Lotus Blossom," the piece which Strayhorn loved Ellington to play.

But there is not a poor track on the LP and, as I said earlier, the Ellington Orchestra has rarely surpassed this form over the years. I would judge this LP to be, quite simply, an essential addition to any jazz record collection. Like the music of the man it honours, it is an album of permanent significance. (T.F.C.)

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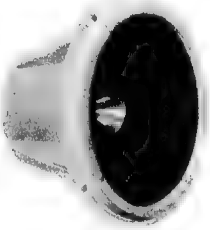

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Important releases on Swaggie label

Most collectors of jazz will be well aware of the admirable Melbourne-based label called Swaggie. In past years, they concentrated primarily on the 7in LP presentation but, about a year ago, Nevill Sherburn, the owner of Swaggie, deleted the entire 7in catalogue. Since then Nevill has produced a steady stream of very important reissues on his 12in Jazz Makers Series. Over the years, and particularly in the past few months, he has been an active supporter of Australian classic jazz with several new recordings to his credit.

Swaggie has a well-established — and completely justified — reputation for a quality product. Swaggie releases invariable have informative sleeve-notes, admirable playing times and are well recorded, remastered and pressed. But most of all, the music is important.

Interested readers should be able to find the range of Swaggie LPs in most of the larger record stores. However, a stamped addressed envelope to Swaggie Records at P.O. Box 125, South Yarra, Victoria will secure a copy of their catalogue with full details of the releases on the Jazz Maker 12in LP Series.

* * *

JAZZ BAND BALL — Several Australian Jazz Bands. Swaggie stereo S1250.

Interest: Australian jazz.
Performance: Generally excellent.
Quality: Well recorded.
Stereo: Normal separation.

The tracks on this LP include four by the Tony Newstead Band from January, 1960, two by Lachie Thomsonn's Big Band from December, 1968, two by the Adelaide Campus Six from March, 1969, three by Melbourne's Red Onion Jazz Band from the same month and one by Len Barnard's Band from November, 1969.

It is, in fact, a splendidly refreshing selection of some first-rate Australian jazz. For example, it is wonderful to have the outstanding trumpeter Bill Munro on record again and his two Campus Six tracks, "Ory's Creole Trombone" and "Muddy Water," are well worth hearing.

Tony Newstead is another great Australian trumpet player and the four tracks by his band show no sign of dating in the 10 years since they were recorded. Listen particularly to "Sunday" and "Davenport Blues."

Melbourne's Red Onion Jazz Band are, quite simply, the most refreshing and exciting jazz band in Australia today and their three tracks (from the Swaggie "Creole Rhapsody" session) show the band at something close to its best. "Jungle Jamboree" and "Black and Tan Fantasy" are both well-rounded, thoughtful instrumentals, while Jimmie Lunceford's "Rhythm is Our Business" features the inimitable dead-pan singing of Bill Howard.

Len Barnard's one track is an alternate take of "Of I Hope Gabriel Likes My Music" from the "Hot Tuesday" session — a classic Australian LP by any standards with superb work by Bob Barnard, Ade Monbourgh, Neville Stribling, Fred Parkes and Graham Coyle.

Finally, the two tracks by Lachie Thomson's Big Band were recorded after the 1968 Adelaide Jazz Convention by an 11-piece band comprising Melbourne, Ballarat and Queensland musicians.

This album is commended to readers who have an ear for traditional jazz in the Australian idiom. (T.F.C.)

* * *

THE BIG BANDS 1928-30 — Louis Armstrong. Swaggie mono S1253.

Interest: First "commercial" Armstrong.
Performance: Enjoyable.
Quality: Satisfactory.

Swaggie has already reissued Armstrong's Five and Seven recordings on 12in LP and the Big Band tracks of the thirties on 7in discs. The 16 tracks on this album represent, so to speak, the interim period, the first recording sessions which Armstrong undertook as a virtuoso soloist with big band backing.

The first two tracks on the LP, "Symphonic Raps" and "Savoyager's Stomp," recorded with the Carroll Dickerson Orchestra in 1928, are extremely rare collector's items.

The next eight tracks were also recorded by Armstrong with the Dickerson Orchestra between July and November, 1929. They include, incidentally, the extremely rare non-vocal takes of "Some of These Days" and "When You're Smiling." The album is completed by six tracks which Armstrong recorded in April and May, 1930, prior to his trip to Los Angeles. These include "Exactly Like You," "Dinah" and "Tiger Rag."

Many collectors regard Armstrong's Big Band recordings as of little interest by comparison with his classic Five and Seven recordings. But I have always had a taste for Armstrong's commercial Big Band work and the tracks on this album are not only historically interesting, but musically enjoyable.

It is only fair to add, however, that many of Armstrong's subsequent Big Band recordings in the 1930s are somewhat superior. Nevertheless, Armstrong collectors will certainly wish to investigate this album. (T.F.C.)

* * *

DIXIELAND BANDS — JAZZ SOUNDS OF THE 20s. Swaggie mono S1254.

Interest: O.D.J.B. 1922 — N.O.R.K. 1925.
Performance: Collector's material.
Quality: Well recorded for the period.

The 16 tracks on this LP are, in the main, relatively rare collector's pieces. Taken as a whole, they provide an interesting picture of the development of white traditional jazz in the early 20s.

Appropriately enough the first two tracks "Some of These Days" and "Toddlin' Blues" are by the Original Dixieland Jazz Band from November 1922 and these two tracks are the only ones on the LP which were not recorded in New Orleans. Again, appropriately, the album ends with two tracks by the Original New Orleans Rhythm Kings from January, 1925, "She's Crying For Me Blues" and "Golden Leaf Strut."

The bands which are represented on the remaining 12 tracks are less well known, but some of the musicians include Johnny de Droit, Johnny Bayers-

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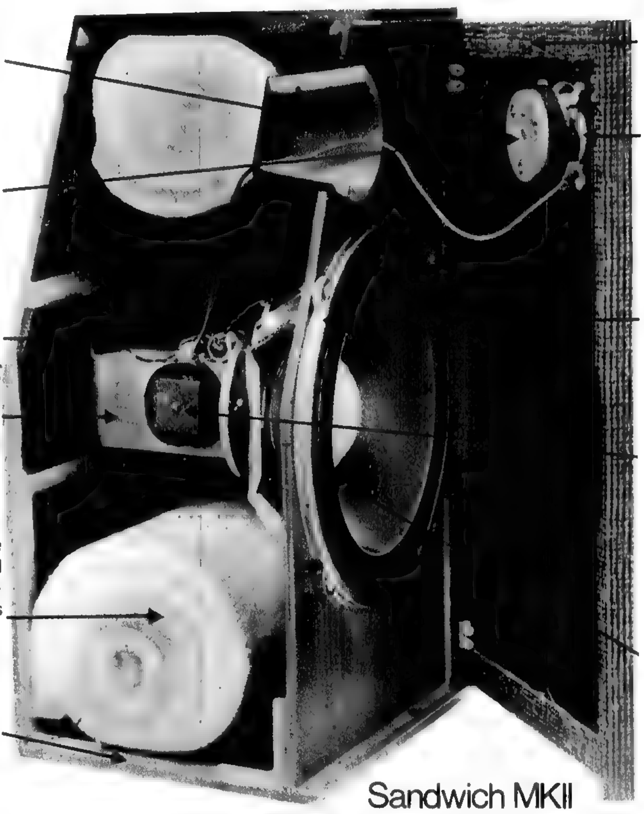
Wood block clamped between magnet and rear panel contributes to cabinet rigidity and damping.

Rolls of multi-cellular mineral wool fulfil dual purpose: (1) eliminate cavity resonances and (2) extend bass response downwards by converting internal air pressure changes from adiabatic to isothermal.

Air-tight outer cabinet, completely sealed and tested against air leakage, gives maximum extension of bass response.



Sandwich MKII

Decorative grille, exclusively woven to exact Leak specification for maximum acoustic transparency.

Both the die cast frame and the baffle hole are shaped and positioned to give flat response by eliminating diffraction and cancellation effects.

Bass unit: stiff, long speech coil, powerful magnet and compliant suspensions ensure large linear excursions of immensely rigid "Sandwich" cone suspended in die cast frame.

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dorffer, Sterling Bose, Tony Parenti, and Sharkey Bonano.

I doubt whether many jazz enthusiasts would argue that this area of jazz was in any substantial way important and influential. But these tracks should fill more than adequately what, for most collectors, must be a gap in their record shelves. Fortunately, Brian Rust's sleevenotes are, as usual, extremely helpful and a veritable mine of interesting and useful information on this period. (T.F.C.)

★ ★ ★

KING OLIVER'S JAZZ BAND 1923. Swaggie mono S1257.

Interest: 1923 Oliver Okeh's.
Performance: Classic recordings.
Quality: Excellently transferred.

The 15 tracks on this LP were available some two years ago in Australia on Parlophone PMC07032 but, for some unaccountable reason EMI deleted the album.

We are therefore indebted to Swaggie for restoring these classic tracks by one of the greatest bands in the history of jazz. They appear, incidentally, in order of recording and represent the Oliver Band's entire output for Okeh. One might perhaps argue that the March/April Gennetts were a shade superior than the Okehs but the recording quality in the latter was considerably better.

In an album so rich with jazz of the very highest quality, the highlights include the cornet duet work in "Mabel's Dream," Baby Dodds' slide whistle on "Sobbin' Blues," the graceful ensemble on "Workin' Man Blues," Oliver himself on "Dippermouth Blues," Armstrong's celebrated nine breaks on "Tears" and Johnny Dodds on "Sweet Lovin' Man."

This, however, was first and foremost a jazz band — beautifully integrated with brilliantly executed and exciting ensemble passages. Most collectors of jazz will already own these tracks on one label or another. But if, for some reason, you are not familiar with these great recordings, this LP becomes essential buying. (T.F.C.)

★ ★ ★

DJANGO SWING — JAZZ FROM THE SWINGING YEARS, VOLS 1 and 2. Swaggie mono S1251 and 1252.

Interest: Especially Django Reinhardt collectors.
Performances: Superb.
Quality: Well recorded and remastered.

These two LPs contain 32 tracks which the guitarist Django Reinhardt recorded with visiting American musicians in Paris between March, 1935 and April, 1939. They have been issued in England under the title "Django and his American Friends" (Parlophone).

Volume 1 finds Reinhardt in the company of Coleman Hawkins, Bill Coleman, Benny Carter, Dickie Wells and several others. Reinhardt's main role was as a rhythm guitarist and he gives Hawkins magnificent support on tracks like "Stardust," "Out of Nowhere" and "Avalon."

But more significant, perhaps, were the six tracks under Dickie Wells' name recorded on July 7, 1937. These tracks are, in my view, classic recordings. On "Bugle Call Rag," "Between the Devil and the Deep Blue Sea" and "I Got Rhythm," Wells and Reinhardt share the spotlight with trumpeters Bill Dillard, Bill Coleman and Shad Collins; on the remaining three tracks "Sweet Sue," "Hanging Around Boudon" and "Japanese Sandman," Reinhardt's magnificent guitar backs Coleman and Wells. Volume 1 of "Django Rhythm" is a worthwhile investment for these six tracks alone.

The second LP is also important for the four tracks which Reinhardt recorded with the violin player Eddie South, including "Eddie's Blues" and "Somebody Loves Me"; and the five tracks on which Reinhardt partnered three of the Ellington Orchestra — Rex Stewart, Barney Bigard and Billy Taylor. These 1939 recordings are "Montmartre," "Low Cotton" and "Solid Old Man" by Rex Stewart and "Finesse" and "I Know That You Know."

Apart from these nine tracks, which are recognised to be of lasting significance, Reinhardt also plays in groups led by Bill Coleman and Benny Carter. The album is completed by a magnificent duet between Bill Coleman and Django Reinhardt called "Bill Coleman Blues."

Both these LPs, which can be obtained separately, contain classic recordings which sound as fresh now as they did more than 30 years ago. Apart from the outstanding solo work by the American musicians, the tracks also demonstrate the unique talents of Django Reinhardt, both as an accompanist of unusual sensitivity and as a soloist of great stature. (T.F.C.)

★ ★ ★

RED ONION JAZZ BAND. Swaggie stereo S1260.

Interest: Outstanding Melbourne Band.
Performance: Polished.
Quality: Well recorded.
Stereo: Well balanced.

This album by the Red Onions, their second for Swaggie, was recorded in Melbourne in October of last year. Its release broadly coincides with their departure for Britain at the start of their second overseas tour. The album is at least as good as their first Swaggie recording, "Creole Rhapsody."

Over the years the Red Onions have worked hard to develop the band's potential, particularly in re-creations of lesser-known jazz compositions of the late twenties and early thirties. Their musicianship has improved remarkably and their ideas have matured. At the present time, the band is clearly international class.

This LP contains the Onions' usual mixture of rare and familiar instrumentals, together with vocals by Bill Howard and Allan Browne. Outstanding among the instrumentals are Benny Goodman's "Breakfast Feud" and Earl Hines' "Rosetta" but, throughout the album, all the main soloists — and particularly Brett Iggulden on trumpet and Bill Howard on trombone — play thoughtful and stimulating music.

Bill Howard's vocal on Cy Oliver's "It Ain't What You Do" and "When It's Sleepy Time Down South" add colour and variety to the band's sound.

Many readers will already know the Red Onions from their recording sessions for the W and G label but the two Swaggies show the band in much more favourable light. This LP can be recommended. (T.F.C.)

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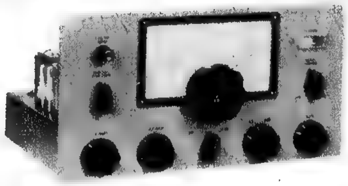

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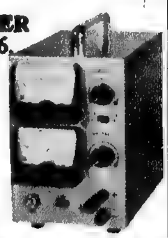

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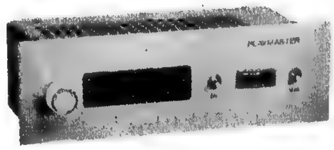

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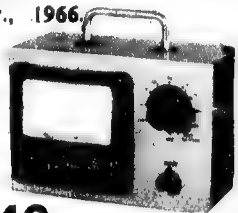

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TRADE REVIEWS AND RELEASES

CELESTION DITTON 15 LOUDSPEAKERS

Recently submitted for review by International Dynamics (Agencies) Pty. Ltd., were a pair of Celestion Ditton 15 loudspeaker systems manufactured by Rola Celestion Ltd., in England. A feature of these loudspeaker systems is the use of a passive radiator to augment the frequency response in the bass region.

The enclosure measures 21 x 9-3/8 x 9½ inches deep and is finished on four sides in oiled teak veneer, so that it can be used either horizontally or vertically. It is constructed of particle board and is braced to improve rigidity. All large panel surfaces are damped with an anti-resonant material and the cabinet is filled with foam to absorb standing waves. The whole construction results in an enclosure which is commendably non-resonant, even at high power operation. The fret cloth is removable to reveal the front-mouthed loudspeakers and it does not show any sign of buzz or rattle.

Bass and middle frequencies in the Ditton 15 system are handled by an eight-inch woofer. This has a deep, curvilinear cone fitted with a synthetic rubber roll surround, the cone itself being treated with a viscous doping material. The chassis is diecast and supports a massive ceramic magnet (Feroba II). Free-air resonance of the woofer is approximately 25Hz.

As already mentioned, the Celestion Ditton 15 loudspeaker is one of the few systems on the Australian market which uses a passive radiator in addition to the main driven cone. It is essentially a variation of the bass reflex system, the difference being that movement of air in the vent (or port) is controlled by a freely suspended passive radiator or so-called "drone cone."

Proponents of the system claim that the passive radiator maintains a uniform movement of air in the port, minimising distortion which can result from non-uniform velocity of air through different areas of the port. They also claim that, by careful choice of passive cone parameters (size, mass, resonance, etc.) improved results can be obtained, particularly from enclosures of limited dimensions.

The passive radiator is unusual in its construction. Most passive radiators take the form of a loudspeaker cone and basket assembly, but with no magnet or voice coil fitted. The Celestion unit is basically a solid cylinder (6-inch radius, 3 inches deep) of what appears to be rigid polyvinyl chloride foam. This is supported in a slotted plastic chassis by two roll surrounds, one at the rear and one at the front. The natural resonance of the complete assembly is a mere 8Hz.

The manufacturers of the Ditton 15 have chosen to modify the behaviour of the system in the bass region by lightly filling the enclosure with an absorbent material. This can be expected to dampen and smooth the response, but it can also be expected to limit the contribution of the reflex system and to produce a gentle roll-off to a characteristic somewhere

between that of a reflex system and a fully sealed and filled "infinite" enclosure. (This is an approach we suggested, some two or three years back, when Bonded Courtelle was released to local hi-fi enthusiasts. It offered a means of damping the space in a resonant system lightly and not too expensively.)

The tweeter in the Ditton 15 is the Celestion HF1300, a unit which has a high reputation overseas and which is claimed to have a response from 3KHz to 15KHz within plus or minus 2dB. It has a cone diameter of approximately 1-3/8 inches; a slotted plate is positioned in front of the cone, presumably to improve dispersion. The crossover frequency from woofer to tweeter is in the region of 3.5KHz.

Listening tests with music and glide-tones confirmed the success of the damped passive radiator system. The bass was maintained level to below 80Hz and tapered thereafter to a usable output down to below 40Hz with slight lumpiness in the region of 50Hz. On most music signals there was little need for bass boost but, if need be, the system can handle any likely amount of bass boost without distress.

The tweeter handles the range of frequencies from 3.5 KHz to 15 KHz, above which it tapers off rapidly. There was some lumpiness in the response in the region of 8 to 10KHz, but this was not serious. The sensitivities of tweeter and woofer were well matched and overall balance on music was good. However, in the region below the cross-over frequency, the tweeter contributes audible colouration and, in this respect, it is not up to the high standard set by the woofer.

The explanation possibly is that the cross-over frequency is not high enough to prevent excessive signal from reaching the tweeter from the region around 2KHz. Having in mind the very small size of the tweeter cone, distress would not be surprising, even at ordinary listening levels. The effect was evident in both samples submitted for review.

It is possible, of course, that the manufacturers may have chosen the best compromise possible, in view of the probable tapering high frequency response of the woofer. It could well be better to have a smooth midrange response with the possibility of slight colouration, than to "cross-over" to the tweeter at too high a

frequency, leaving a dip in the response which would make the system seem to lack "presence." And make no mistake, compromises of this nature are necessary in all but the most esoteric sound reproduction equipment.

Despite this criticism, the overall standard of reproduction was very good, particularly on organ music, where many loudspeakers are just not able to give a "large as life" reproduction.

The efficiency of the system is quite good and is suitable for all amplifiers with powers of 10 watts or more. As noted above, there is little need to boost the bass.

The price of this well-finished system is unfortunately boosted by import duty, but at a retail price of $94.50 each it is certainly not unreasonable. It is available from dealers in all States.

Trade inquiries should be made direct to the sole Australian distributors, International Dynamics (Agencies) Pty. Ltd., 4 Duke Street, Abbotsford, Victoria, 3067, who can supply information on these and other products in the Celestion range. (L.D.S.)

ADDITIONS TO THE TEKTRONIX RANGE

Tektronix Australia Pty. Ltd. have advised availability of the following additions to the company's oscilloscope range.

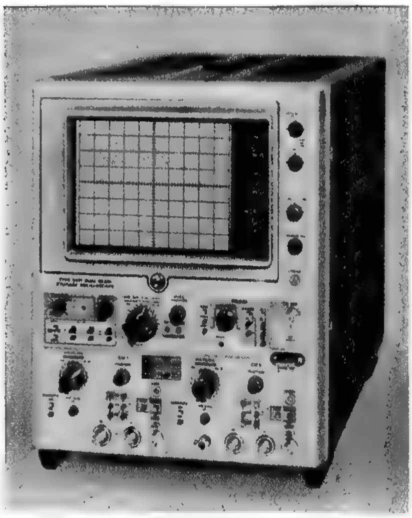
Type 5031 dual beam storage oscilloscope. Tektronix say this is the first commercially available dual-beam, bistable storage oscilloscope. It offers high-gain, differential-voltage inputs of 10uV per division, current probe inputs of 1mA per division for each of its vertical beams, fibre-optics auto scale-factor readout, and 1MHz bandwidth. Other features are: variable viewing time system, which can be directed to automatically erase either or both halves of the display area after a predetermined viewing time; remote control of all storage functions via a nine-pin connector located on the rear panel; illuminated push-buttons that indicate operating modes; a beamfinder that acts as a locate function when the CRO is used in the store mode, and normal beamfinder in the conventional mode.

Type 7503 Oscilloscope and Type 7B52 Time Base. These are new additions to the recently established 7000-Series oscilloscope system. The 7000 series is a full measurement system currently consisting of three mainframes and 14 plug-in units, including six amplifiers, five time base units, two sampling units and a dual delay line plug-in unit.

The 7503 is a 90MHz three plug-in oscilloscope with a dual trace vertical amplifier in the mainframe provided by vertical mode switching. Vertical mode switching allows the user to simultaneously measure waveforms with widely different characteristics by electronically switching between two vertical plug-ins. The vertical mode offers both "chopped" and "alternate" operation, and the modular approach to plug-in selection provides a better match between instrument and application, allowing a wide range and combination of multi-trace, differential, high-gain, current and sampling input configurations.

The 7B52 Time Base is designed primarily for the 7503 (which has a single horizontal compartment), but is also compatible with any 7000 Series mainframe. It features normal, intensified, delayed and mixed sweeps. Each sweep mode is quickly called into use by pressing a lighted push-button control.

Further details are available from Tektronix (Australia) Pty. Ltd., 80 Waterloo Road, North Ryde, N.S.W., 2113, or branch offices in Victoria and South Australia.



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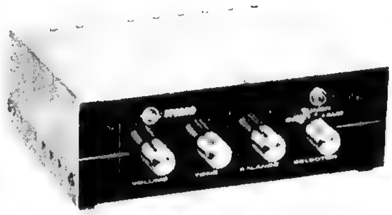

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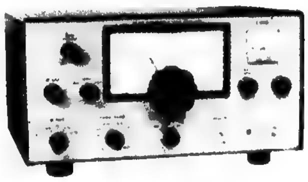

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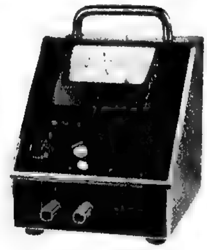

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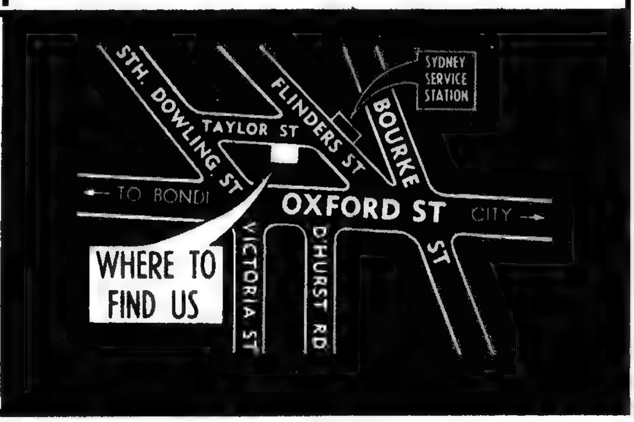

JEMCO 50,000 ohms/volt multimeter

Indeva Pty. Ltd. recently submitted for review a Jemco US-105 multimeter which is very similar to the Jemco US-100 except that it has higher sensitivity. It is compact but has a large easily read scale, a sensitivity of 50,000 ohms/volt on DC, a 10-amp AC range and meter overload protection as its main features.

The DC voltage ranges, with a sensitivity of 50,000 ohms/volt are 250mV, 1.0, 2.5, 10, 50, 250 and 1,000 volts. AC voltage ranges have a sensitivity of 10,000 ohms/volt and are as follows: 2.5, 10, 50, 250 and 1,000. The accuracy of voltage ranges was not quoted but was found to be within 3 per cent of FSD on all ranges and this is adequate for most use. The reference which we checked against is a digital voltmeter with an accuracy of the order of 0.1 per cent.

The frequency response of the AC voltage ranges was found to be very good for an instrument of this type. It was flat within 1dB up to 50KHz. This feature, combined with the low voltage ranges and high sensitivity, makes the instrument quite useful for general audio applications.

Ohms ranges are x1, x10 x100, x1,000 and x10K. The centre-scale reading is 100 so that all common resistor values are easily checked. The ohms ranges are powered by two 1.5V penlite cells on the low ranges and a 22.5 volt battery for the highest ranges.

An interesting point is that the penlite cells must be fitted with steel sleeves which are provided with the multimeter. When we made our initial test of the multimeter we did not fit the cells or the sleeves and the results showed the meter was reading a consistent 6 per cent high on all ranges. Indeva Pty. Ltd. subsequently advised us the batteries and their steel sleeves must be fitted for the meter to read accurately.

Apparently, the steel cases of leakproof cells act as a magnetic shunt for the sensitive meter movement and this has been compensated for. However, since leakproof cells will not always be used, the designers have decided to eliminate this variable by supplying sleeves to be fitted to all cells, whether leakproof or not.

There was no instruction in the literature accompanying the multimeter stating that the sleeves must be fitted for accurate operation of the meter and we would suggest that these instructions be added. Indeva Pty. Ltd. advise that a new model of the meter to be introduced soon will have an integral shield in the battery holder which will be a permanent fitting.

All ranges are selected by a large, easily manipulated rotary switch. Extra sockets are used for the 50uA, 250mV and 10-amp ranges. A polarity reversal switch is provided to facilitate DC measurements. Meter overload protection is incorporated and we tested this with a variety of overload conditions which the meter withstood without sign of damage. This feature protects the meter movement only and really severe overloads would probably damage the internal circuitry.

The unit is housed in a moulded plastic case measuring 5¾ x 4 1-8 x 1¾ inches, not including the handle. The dial carries six ranges but these are quite easy to read. A mirror is also provided on the dial to minimise parallax error. The meter zero position is easily reset, using a small knob instead of the usual screwdriver adjustment.

To sum up, the unit is well made and has quite a wide range of applications and, as we observed above, is straightforward to use. Price is $30 plus tax. It is available from all trade houses and the distributors, Indeva Ptq. Ltd., have spare parts and repair service available.

Further information regarding this and other test equipment can be obtained from Indeva Industries Developments Pty. Ltd., 24 Bellevue Road, Bellevue Hill, N.S.W. (L.D.S.)

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MOS IC counters, types HCTR0117 and HCTR0107. Each consists of an up-down presettable counter, storage register, seven-segment decoder and driver transistors on a single MOS chip. The inputs provide for presetting the counter to any count using a 8-4-2-1 code, a clock-in, set enable, storage enable, or up-down control. Outputs consist of a clock output, BCD outputs and seven driver FETs, each rated at 40V, to operate indicating devices.

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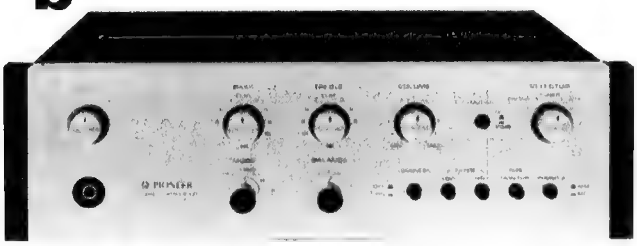

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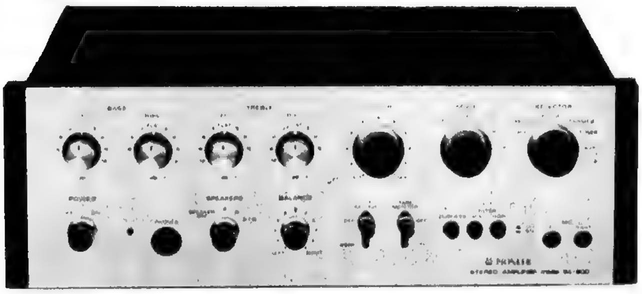
Music Power Output:	120watt at 4ohm(dist. below·5%)
Continuous Power Output:	88watt at 4ohm(dist. below·5%)
Frequency Response:	20Hz to 40kHz ±1db
Power Bandwidth:	15Hz to 60kHz(dist. below·5%)
Harmohic Distortion:	Less than .05%(20watt at 1kHz)
S/N Ratio:	MAG 85db) Volume: Max. tone AUX 100db) flat at the rated) output — 1 HF.

c



SA 900

Music Power Output:	200watt at 4ohm(dist. below .3%)
Continuous Power Output:	168watt at 4ohm(dist. below .3%)
Frequency Response:	20Hz to 50kHz ±1db
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The Advance OS2100 Oscilloscope is a fully solid-state instrument offering a high degree of performance and reliability at moderate cost. With the Dual Trace wide band Plug-in module fitted, the bandwidth is DC to 30MHz or better at 10mV/cM sensitivity.

The OS2100 is constructed on the main frame/plug-in module principle and is almost identical in external appearance to the OS2000 oscilloscope reviewed in the May, 1969 issue of "Electronics Australia." As with the OS2000 model, a range of X and Y plug-in amplifier modules is available so that the C.R.O. is quite flexible in its application.

Pictured in position in the main frame are the OS2002Y Dual Trace Wideband Y amplifier and the standard Timebase type OS2003X. Other Y units available are a Single Trace wideband unit and Single Trace Differential unit. Other X units available are a Delay Sweep Timebase and a Wide Range Timebase.

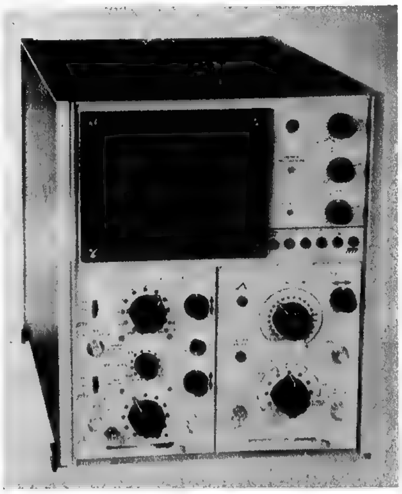
The CRT is a single gun rectangular flat face type with helical PDA (post deflection acceleration) electrode operating at 10KV. This gives sharp focusing and a bright trace at rapid sweep rates. The display area is 10cM x 6cM A graticule illumination control is provided, together with preset controls for astigmatism and trace rotation.

A feature of the power supply circuitry is the use of a constant voltage power transformer to stabilise the supply rails. Apart from allowing the C.R.O. to be used with a wide range of supply voltages, this also has the effect of suppressing transients on the mains supply and thus prevents false triggering.

The Y deflection circuitry in the main frame incorporates a twin coaxial line to provide approximately 200nS of post triggering delay. This allows inspection of the leading edge of most types of waveform.

Available on the front panel of the main frame are five square wave calibration signals derived from the power supply circuitry. Amplitudes of these 250mV, 100mV, 50mV, 5mV and 0.5V all at 50Hz. These are accurate to within plus or minus 2 per cent. The rear of the main frame provides an input for Z modulation (beam modulation) which requires a signal of 70 volts peak-to-peak for full modulation.

Each channel of the Dual trace Y amplifier OS2002Y provides an input sensitivity of 10mV/cM at a rated bandwidth of DC-30MHz. Input impedance is approximately 1M/35pF and the input attenuators provide eleven sensitivity ranges from 10mV to 20V in the usual 1-2-5 sequence. In addition, each channel has a variable sensitivity control giving a 3:1 uncalibrated gain variation. Provision is made for both chanels to be AC coupled in cascade to give an effective sensitivity of 1mV/cM with a bandwidth of 5Hz to 5MHz.



Maximum input rating is plus or minus 400V for DC and LF signals with derating for RF signals.

The dual trace module is a beam switching unit. Interlocking with the time base is provided, such that high frequency (100KHz) chopping is selected automatically for sweep speeds under 1mS/cM, and alternate-sweep switching for the higher speeds. A mode switch allows selection of the signal from either channel, both together or the sum of the two. One channel can also be inverted to give the difference of the two. This sum and difference facility is one not often seen on C.R.O.s in this price range and is a handy feature.

Nineteen basic sweep ranges are provided on the OS2003X Timebase module, spanning from 200mS/cM to 200nS/cM in the usual 1-2-5 sequence. An uncalibrated variable control gives 3:1 interpolation capability, while a 5X gain switch provides magnification and extends the maximum speed to 40nS/cM.

Triggering sensitivity for internal signals is typically 1.5mM trace height and externally 300mV P-P. Triggering modes selectable include internal, external, powerline, TV field, and free run.. Trigger slope may be set for either positive or negative polarity, and trigger level may be either set for automatic mean level operation or manual adjustment. There is no front-panel triggering stability control.

The timebase module provides for sweep disabling and external X input, the input sensitivity being 10V (2V in the 5X position), and the rated bandwith DC — 250KHz. It also provides front-panel sawtooth and step signals, the former for external use and the latter for adjustment of probe compensation.

The plug-in modules of the OS2100 are fitted with a nylon retaining spigot which holds them securely in position during operation. A simple quick release mechanism enables them to be withdrawn easily. All signal connections to the modules are by "BNC" coaxial connectors and a matching cable and probe set, together with adaptors for other types of connector, is available as an optional accessory.

On test, the OS2100 plus plug-in modules performed very well. Sensitivity, bandwidth, stability and control operation were as specified or better. We found the instrument a pleasure to use.

The only criticisms we make are minor and are mainly concerned with the external appearance of the unit. The plug-in modules were a rather loose fit in the frame and while this is possibly intentional and certainly does not affect the electrical performance, it does tend to give a poor impression. I suppose this is a case of "do not judge a book . . ."

The other criticism concerns the Dual-Trace Y-amplifier module. At low sweep speeds and at high brightness settings, the trace chopping wavefrom was superimposed on the beam. This is admittedly not noticeable in normal use.

Overall, the unit must be regarded as very good value for money. To the best of our knowledge, no other manufacturer offers this order of performance at a comparable price. Price of the OS2100 is quoted at $680 for the main frame, $85 for the single-trace plug-in, $149 for the standard timebase plug-in, $255 for the dual trace plug-in, and $25 for the probe and cable kit; plus tax in each case, if applicable.

Australian distributors of Advance equipment are Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, to whom all inquiries should be directed. (L.D.S.)

Australian-made electrocardiograph

WATSON VICTOR LTD., 95-99 Epping Road, North Ryde, N.S.W. 2113, is in production with a new electro-cardiograph which it says is the most advanced unit of its type made in Australia.

The new instrument, Cardiotrace 300 electrocardiograph, uses microcircuitry and integrated circuits. It is described as a compact, light and portable, single-channel, direct-writing ECG, and is one of the first completely new developments from the company's recently re-organised and Government-registered research and development division. Its frequency response exceeds the requirements of the American Heart Association, whose specifications are currently under consideration for inclusion in an Australian Standard for direct writing electro-cardiographs.

Features of the unit's performance are:

It strongly rejects all external electrical interference.

Its exceptional frequency response makes it more sensitive than previous ECGs to required signals originating within the patient's body.

By removing unwanted patient interference, the resulting cardiogram is of greater diagnostic value.

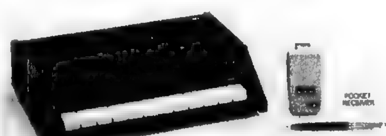
The safety factor is very high, as the patient is not connected directly to earth. Instead, an internal instrumental system provides an earth connection of very high impedance, which limits the current flow through the measuring system to a very small value.

TRADE RELEASES -- in brief

SCIENTIFIC ELECTRONICS PTY. LTD. P.O. Box 61, Blackburn, Vic. 3130. **Power modules.** Series voltage regulators with a high degree of regulation for instrumentation, telemetering and industrial control use. Features include: fully protected against current overloads by a current cut-back circuit; output voltage adjustable for accurate setting of nominal voltage; free of turn-on, turn-off transients; single and dual supplies available, the latter with both master and slave regulators; both regulators collapse symmetrically if either is overloaded; printed circuit board construction compatible with accepted standards such as ISEP and DEC systems; chassis mounting connector types also available; available in a range of voltages from 3.5 to 24V at current ratings from 0.5 to 2.5A.

Step drivers. Designed to drive stepping motors, but can be used to drive solenoids, relays or control valves in sequence. The units accept pulses from an outside source (e.g. tape recorder, translator, computer, clock) and translate them into appropriate phase switched DC driving sequences. Six instant reversible driving sequences are available. Capable of driving up to 5A at 55V and suitable for any stepping motor. Compatible with accepted standards such as ISEP and DEC systems; chassis mounting connectors are also available.

ALLAN ELECTRONICS PTY. LTD., 59A International House, 104 Bathurst Street, Sydney, 2000. N.S.W. distributors of Strato Communications Pty. Ltd. **Compact radio paging system.** To provide coverage of industrial, hospital, and office establishments. The low-cost system comprises



a transmitter, encoder and up to 110 pocket-sized individual units, each of which weighs 2½ ounces. Calls to the units are controlled by operating keys on the encoder. On receipt of the radio mipulse, the pocket unit emits an audible tons to alert the wanted party.

AMALGAMATED WIRELESS (A'ASIA) LTD., Consumer Products Division, 554 Parramatta Road, Ashfield, N.S.W. 2131. Agents for A.W.A. New Zealand Ltd. **Ortho-Fidelity stereo systems.** A range of the audio equipment designed and manufactured in New Zealand is now available in Australia. The range includes: ST953 integrated AM tuner-amplifier; ST95 stereo amplifier (90W music power rating); ST45 stereo amplifier (40W music power rating); AM3 broadcast tuner; Studio monitor Mk II loudspeaker system; Monitor Mk II loudspeaker system. Also available to complement the systems are the B & O SP6 magnetic cartridge and the PE 2020 Combi turntable.

PLESSEY DUCON PTY. LTD., P.O. Box 2, Villawood, N.S.W. 2163. **Silvered mica capacitors, SD6M series.** Intended for military, professional and other applications requiring high stability, low losses, high reliability and extreme climatic protection. The capacitors meet or exceed the requirements of MIL-C-5C and MIL-STD-202, and have estimated failure rates per 1,000 hours at 90 per cent confidence level ranging from 0.15 per cent at 125 degrees C and 500VDC to .0001 per cent at 85 degrees C and 250VDC. Standard capacitance values available are 5, 6, 7, 8, 10, 12, 15, 18pF followed by the 5 per cent preferred series and decimal multiples of such values. Working voltage is 500VDC.

RUTHERFORD ELECTRONICS PTY. LTD., 62 Jackson Court, East Doncaster, Vic. 3109. Agents for National Semiconductor Corporation, U.S.A. **Hybrid integrated circuit, NH0012.** To convert standard TTL or DTL logic levels to MOS clock logic levels. Features include. output swing from 12 to 30V to drive either high or low level MOS devices; can drive MOS shift register clocks at a 10MHz rate; designed to be driven by a TTL or DTL line driver or high current buffer; provides a fixed width output clock pulse with a 1000mA maximum output current capability.

HOLMESDALE PTY. LTD., 299 Kent Street, Sydney, 2000. Distributors for Teijin Ltd., Japan. **Moulding resin, type FR-PET.** A glass reinforced polyethylene tetraphthalate moulding resin suitable for relays, TV tuners, coil bobbins, incandescent lamp housings, terminal boards, multi-way connectors, thermostats, encapsulation of semiconductors, etc. Features include: heat distortion temperature of 240 degrees C (said to be the highest among all thermoplastic materials); tensile strength is 1450Kg/sq cm; excellent chemical resistance; self-extinguishing; resistant to abrasion and wear.

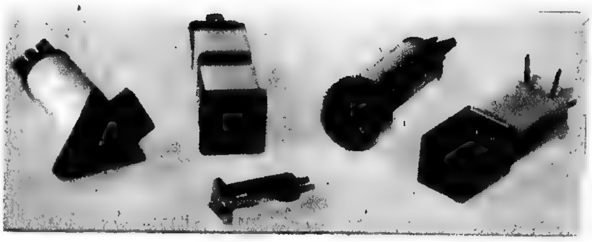
PLESSEY DUCON PTY. LTD., P.O., Box 2, Villawood, N.S.W. 2163. **Complete fluidic systems.** To offer customers all the advantages of fluidics, Plessey is establishing an engineering team which will undertake system design, in consultation with the customer, as well as manufacture and assembly. There will also be a continuous development of fluidic control modules to offer solutions to many specific problems.

Fluidic level control module. The device needs only an industrial air power source, as it has an internal regulator and filter to ensure a supply of clean air at constant pressure to the fluidic elements. A number of alternative outputs, including high pressure air, are available so that the system can operate without risk in the most explosive or inflammable environments. The module can be used to control either powders or liquids, normally between high and low limits, but if required a single specified level can be held to within 2mm. The only contact with the material under control is via dip tubes. These can be of any length or material but are usually 8mm OD copper tube unless otherwise required. The module is in a box 6in x 6in x 3in with standard fittings for 4mm OD copper or nylon tubing for the air supply.

NATRONICS PTY. LTD., The Crescent, Kingsgrove, N.S.W. 2208. **Precision power supplies, LD series.** Features include: IC operational amplifiers to ensure high performance and reliability; both constant voltage and constant current operation with automatic changeover from one mode to the other; current and voltage outputs controlled by precision 10-turn potentiometers, mounted on the front

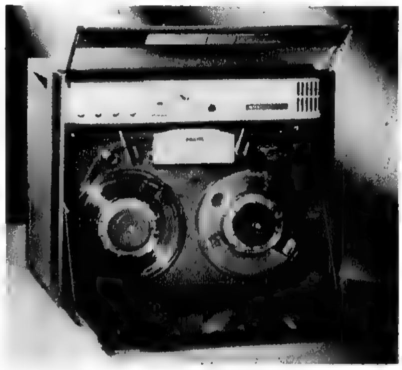
panel, and indicated by separate meters; the output can be programmed by external resistive or voltage source; remote error sensing compensates for voltage drop in output leads; output impedance less than .001 ohm from DC to 10KHz; line and load regulation better than .01 per cent. Three units are available: LD 30/1, 0-30V, 0-1A; LD 6/4, 0-6V, 0-4A; and LD 40/5, 0-40V, 0-5A.

E. S. RUBIN & CO. PTY. LTD., 73 Whiting Street, Artarmon, N.S.W. 2064. Agents for Rafi, West Germany. **Miniature and sub-miniature lampholders and pilot bezels.** Of sealed plastic construction, the miniature units are available with either neon or low-voltage incandescent lamps, covering a voltage range from 6 to 220V, and in a variety of physical shapes and colours. The sub-miniature types are available with incandescent lamps only, for 6, 12 and 24V operation. There is also a square bezel lampholder (far right) for printed wiring applications using a replaceable "short lilliput" 6 to 60V lamp.



Samples from the range of Rafi components.

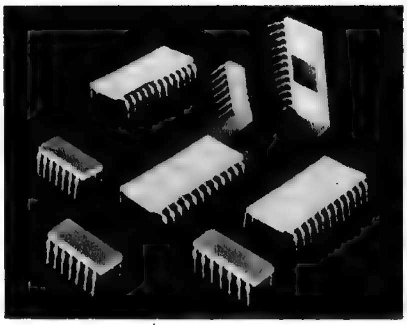
PHILIPS ELECTRICAL PTY. LTD., 69-79 Clarence Street, Sydney, 2000. **Four-channel communications recorder, type XMN 4.** Available in three versions: as a four-channel recorder giving 12 hours non-stop recording on four tracks simultaneously; as a two-channel recorder for 24 hours recording; and as a single-channel recorder for 48 hours recording. In the latter two versions, the XMN 4 is fitted with an automatic reversing device which reverses the direction of tape travel at the end of the tape and at the same time switches the recorder to another track. Where the information to be recorded is at irregular intervals, the XMN 4 can be fitted with a voice-operated relay. Attack



time is 0.2 second, release time adjustable between two and 60 seconds.

The number of controls has been kept to a minimum. Operation is by push-buttons which require only slight finger pressure. A switched test meter allows a check on all critical voltages and currents during operation. Monitoring of each channel individually or any combination is possible during recording. The recorder has complete playback facilities for all channels.

MINIWATT ELECTRONICS DIVISION, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064. **MOS digital integrated circuits, FD family.** A series of complex monolithic ICs using MOS enhancement mode P-channel technology. Features include: output compatible with MOS TTL and DTL; metal/ceramic DIL package; protected input gates; custom ROM patterns for quantities as small as 10. The family includes: FDN106, quadruple 32-bit dynamic shift register; FDN126, variable length 1 to 64-bit dynamic shift register; FDN146, 256-bit dynamic shift register; FDN116, FDN136 and FDN156, two-phase clock versions of the above; FDQ106, 128-bit random access memory with 1uS access time; 256-word, 9bits/word read-only memories FDR106Z (bit pattern to customer's specification) and FDR106Z1 (version with a fixed bit pattern); 512-word, 5bits/word read-only memories FDR116Z (bit pattern to customer's specification) and FDR116Z1 (with fixed bit pattern for dot code matrix character generator). The bit patterns stored in the

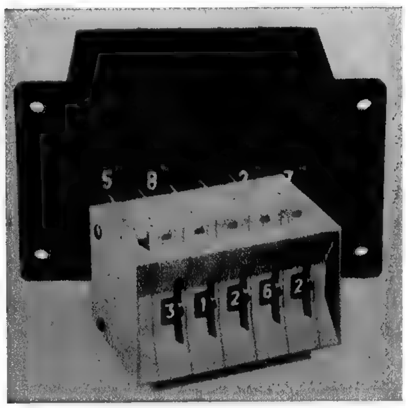


FDR106Z1 can perform the following functions: starburst character generation; starburst pattern generation; seven segment decode; selectric to ASC11 code conversion. The FDR116Z1 is intended as a character generator for a display system in which each character is presented as a dot code matrix of seven rows of five bits each.

A & R ELECTRONIC EQUIPMENT CO. PTY. LTD., P.O. Box 170, Box Hill, Vic. 3128. **Power transformers.** Type P.T.6586 is said to be suitable for the Playmaster 128 Stereo Amplifier, described in the January, 1970 issue of "Electronics Australia." P.T.6586 was originally designed for the Solid State Guitar Amplifier, published in July, 1969. Type P.T.6474 is equal to the transformer specified for the Musicolour, published in October, 1969, but does not have a high voltage barrier between the 240V primary and core. The company has consequently fitted a mylah film barrier to stop possible flash-overs. The new version with the film is known as P.T.6474A.

AMALGAMATED ELECTRONICS SERVICES PTY. LTD., 15 Kathleen Parade, Panania, N.S.W. 2213, has been appointed sole agents for Kynmore Engineering Co. Ltd., of the U.K., for the distribution of thumbwheel switches, and analog and digital dials.

Thumbwheel switches, types "Mini-Stac" CS-120, CS-121 and CS-400. Available in either binary coded decimal, with or without complement, or as a straight decimal 10-position unit. Each module is less than 0.3in wide with an overall height of 1.14in (29mm). Symbols are 4mm high, white on grey or black body. Contact material for binary units is nickel-rhodium-silver-palladium on gold; for the decimal units it is nickel-gold-silver-palladium on gold. Break-before-make and shorting contacts are available on request. If desired, the switch can be delivered illuminated and/or humidity proof.



The Kynmore "Mini-Stac" switch compared with its predecessor, the "Multi-Stac" switch.

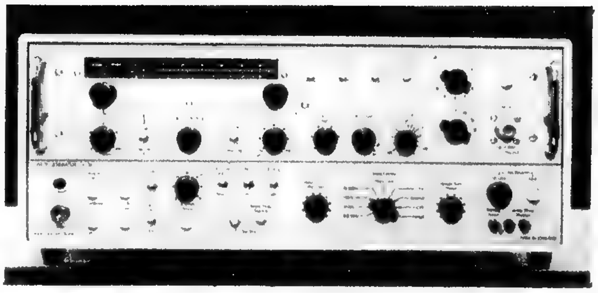
AURIEMA (AUSTRALASIA) PTY. LTD., 443 Kent Street, Sydney, 2000. Agents for the Raytheon Company's Micro State Electronics Operation, U.S.A. **Gallium-arsenide avalanche diodes.** Engineered for high power solid-state sources and amplifiers requiring maximum efficiencies, these impact avalanche transit time (IMPATT) diodes are said to give higher DC to RF efficiencies for high power CW levels compared to other solid-state microwave devices. Special frequencies, output powers, efficiencies, packages, as well as other selected low noise devices, are available. **Low-distortion, low-noise telemetry transistor amplifiers, series TQW.** Cover both the normal L and S band telemetry ranges in one standard unit. Feature: wideband coverages between 1.4 and 2.3GHz; high gain (up to (22.0dB); low bandpass ripple; low power consumption; compact size. **Series TQN.** Low noise amplifiers improved with higher gain (to 25dB) lower noise figure, improved VSWR, and 1dB compression point characteristics.

ELECTRO-PAK COMPONENT SUPPLIES CO., P.O. Box 731, Canberra City, A.C.T. 6201. Agents for Iskra P.S.O., Yugoslavia. **Carbon layer resistors, series UPM.** Features: highly stable cracked carbon construction; minimum temperature coefficient; resistant to humidity; resistant to short-term overload; low noise level; miniature size. The resistors are available in ½W dissipation, 5 per cent tolerance from 4.7 ohms to 2.2M, and 10 per cent from 2.7M to 10M.

Agents for Arco S.p.A., Italy. **Miniature epoxy-dipped polyester capacitors.** Features: polythene terephthalate dielectric; non-inductively wound; low loss angle; high insulation resistance in adverse climatic conditions; high dielectric stability; small size; suitable for horizontal or vertical mounting; epoxy resin encapsulated. Capacitors are available in 10 per cent tolerance, with a nominal working voltage of 160V DC (90V AC) and values from .001uF to 0.47uF.

MATSUSHITA ELECTRIC CO., (AUST.) PTY. LTD., 321 Pitt Street, Sydney, 2000. **National television receiver model TW520C.** Fitted with a cassette tape recorder which can record the sound from a TV program being shown or be used separately to record from a radio or microphone. Play-back is through the set's twin speakers. The cassette recorder can also be used to play pre-recorded tapes. When a cassette finishes playing, the recorder stops automatically and ejects the cartridge. Recording time is one hour, using two-track C-60 cassettes. Track speed is 1-7/8ips.

The receiver also includes National's



AMALGAMATED WIRELESS (AUSTRALASIA) LTD., Engineering Products Division, P.O. Box 96, North Ryde, N.S.W. 2113. Distributors for Marconi Instruments Ltd., U.K. **Sweep generator model TF 2361.** Available as either a video or VHF unit using plug-in units. The basic unit contains common power supplies and circuitry for driving the plug-in units. Features of the main unit include: removable chassis units to simplify servicing; voltage controlled oscillator as primary driving source; sweep speeds from .01Hz to 100Hz; sweep to fly-back ratic of 1:1 or 10:1; oscillator can be locked to mains or to a composite TV waveform; can be operated as single-shot or manual, or can be swept by an external signal between DC and 20KHz; markers derived by mixing swept output with harmonic output from marker oscillator to produce comb marker effect; blanking available at front panel for external sync; dual-trace facility, calibrated to measure 0 to 1dB either side of the reference, enables precise measurement of small changes in level.

The video plug-in unit features: frequency range 25KHz to 30MHz; linearity (the deviation of any marker from expected position with respect to full sweep width) within 2 per cent; flat response, better han plus or minus .05dB over complete range using video detector; harmonic and spurious signals are typically 50dB and 60dB down respectively; a bistable circuit enables alternate traces to be separated by up to 1dB for flatness checks.

The VHF plug-in unit features: Frequency range 1MHz to 300MHz; linearity better than 2 per cent; alternate trace facility also controls marker display; this provides either 1MHz markers on one trace and 10MHz markers on the other, or 10MHz on one and 100MHz on the other; maximum trace separation 1dB; harmonic and spurious outputs typically 35dB and 40dB down respectively.

"20/20" tuning system which is used as follows: the fine tuning control is pushed in; a white vertical band appears on the TV screen; the tuning control is turned until the band is at its narrowest width; when the control is released, the band vanishes and the set is in correct tune. Once adjusted, the fine tuning remains constant regardless of the number of channel changes.

Mr N. C. Stevens

STANDARD TELEPHONES AND CABLES PTY. LTD. has appointed Mr N. C. Stevens, assistant managing director, as an associate director on the board of the company. Mr Stevens has been in charge of the company's Liverpool operations since he joined S.T.C. on July 1, 1967.

RUTHERFORD ELECTRONICS PTY. LTD., P.O. Box 30, North Balwyn, Vic. 3104, has been appointed as representative for United Aircraft and also for the electronic components division of the Allen-Bradley Co., both of the U.S.A. The United Aircraft range includes silicon RF to microwave power transistors, tight tolerance silicon dioxide capacitors, tantalum nitride resistor 4-bit ladder networks, and Darlington power switches for stepping motors or servo systems. Allen-Bradley is a world leader for hot moulded resistors and potentiometers, with 35 years experience in the field. Rutherford will stock a full range of the resistors and a representative range of variable resistors, attenuators and trimmers, both multi-turn and single-turn.

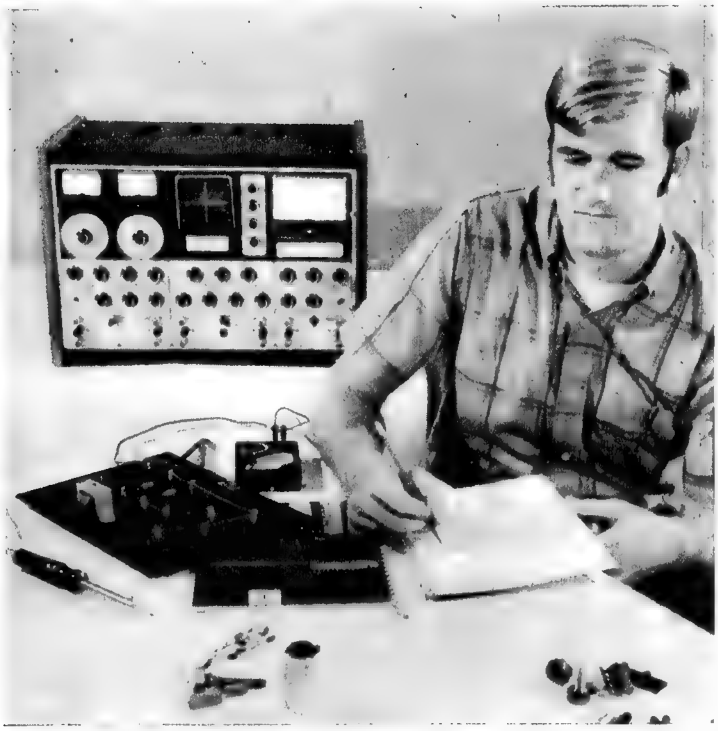
MARKETING TECHNOLOGY, Standards House, 80 Arthur Street, North Sydney, N.S.W. 2060, a new consulting service in N.S.W. and Victoria, is directed by Mr R. E. Hare, formerly marketing executive of Plessey Telecommunications Pty. Ltd. Mr Hare has been associated with the electronics industry in the U.K. and Australia, and has varied experience with semiconductors, computers and automation. He has travelled extensively in Europe, including the U.S.S.R., and the U.S.A., and is a B.Sc. (Electrical Engineering) graduate of London University. The company will provide a complete service in all aspects of marketing, covering feasibility studies, market research, business planning, tactical planning, sales training, literature, media plans, public relations, and industrial films.

IRH COMPONENTS PTY. LTD., The Crescent, Kingsgrove, N.S.W. 2208, has been appointed Australian agent for Hirose Electric Co. Ltd., Tokyo, Japan. Hirose products include miniature and standard RF coaxial connectors, circular and rectangular plugs and sockets, printed circuit edge connectors, and special cable connectors for telecommuniations applications.

PLESSEY PACIFIC PTY. LTD. has appointed Mr P. J. Townsend as commercial manager responsible for the marketing operations of the three companies in Victoria and South Australia — Plessey Rola Pty. Ltd., Plessey Electronics Pty. Ltd., and Plessey Dynamics Pty. Ltd. Prior to this appointment, Mr Townsend was marketing manager of Plessey Communication Systems Pty. Ltd., in which position he has been succeeded by Mr D. B. Ground.

HEWLETT-PACKARD AUSTRALIA PTY. LTD. has announced the following appointments. Mr Jim Creed has been appointed southern area sales manager responsible for sales throughout Victoria and Tasmania, and located at head office in Glen Iris, Victoria. Mr G. R. (Dick) Graf has been appointed manager for A.C.T. with premises currently being established at Dickson, A.C.T. Mr Malcolm Kerr has been promoted from product specialist to data product sales manager responsible for sales of digital computers, peripherals, systems, and calculators throughout the Australasian area.

Mr J. Creed *Mr G. R. Graf*



TECHNICAL BOOKS AND PUBLICATIONS

Systems of units

SYSTEMS OF UNITS IN ELECTRICITY AND MAGNETISM. By Leo Young, M.A., M.S., Dr. Eng., M.I.E.E., Fellow I.E.E.E. Published 1969 by Oliver and Boyd, Edinburgh. Stiff paper covers, 235 pages 8½ x 5½ inches, mainly text and tables. Price in Australia, $6.30.

This is one of a new series of textbooks, of which the first five were published last year. The other four titles currently available are: "Electrical Power Systems, Vol. 1," "Digital Computer Design," "Electromagnetic Theory, Vol. 1," "Theory of Communication." Eight more titles are to follow, all related in one way or another to electrical theory or electronics.

The preface explains that the books have been conceived and planned as a whole to provide a more or less self-contained set of references to undergraduates in electrical and electronic engineering. While carefully planned and thorough, they are also economically priced, so as to fit the limited budgets within which many students have to work.

The author, Leo Young, is a man with a considerable academic background, being attached at the time of writing to the Stanford Research Institute, Menlo Park, California. Edited by Professors P. J. B. Clarricoats and P. J. Lawrenson, the book has also had the benefit of co-operation from a number of other people whose help is acknowledged.

In Part A of the book, entitled "Units and Dimensions," there are five chapters, as under: "Basic Concepts," "Base Quantities in Mechanics," "An Extension of the Concepts of Units and Dimensions," "The Fourth Dimension of Electromagnetism," "Maxwell's Equations in Six Common Metric Systems."

The subject is attacked from a quite elementary and fundamental level but, while the author early exhibits a facility with prose, he does not attempt to stay on a descriptive level for the casual reader. He resorts to mathematical terms and notations appropriate for the serious student.

In part 2 of the book entitled "Transitional Units and Equations," the chapter headings are: "The Fifth and Sixth Dimensions of Electromagnetism," "Geometrical Interpretation of S and U," "The Generalised CGS Systems," "The CGS Practical System (Hansen Units)," "Concluding Remarks."

The appendices at the end of the book are particularly comprehensive and relevant. Summarised, they include: Tables; MKS and CGS Units; SI Units; Prefixes; Standards Authorities; Metric Units in Britain and U.S.A. Professional Societies Involved; Formulas Involving S and U; Mechanical SI Units; Rationalisation; Physical Constants; Bibliography; Greek, Hebrew Alphabets; Notation; Glossary.

While it would take far more time than this reviewer had to analyse the book in greater detail, one gains the impression that if a problem has to do with units and measurements in the intended field, the key to it will be in this book. This is particularly good value for those who need a reference text of this nature. Our review copy came from Rigby Limited, 30 North Terrace, Kent Town, South Australia. (W.N.W.)

Industry directory

CETIA NATIONAL DIRECTORY 1970. Published in conjunction with the 1970 National CETIA Program. Published by the National CETIA Program, Box 3629, G.P.O., Sydney 2001. Stiff paper covers, 272 pages, 5½ x 8½in. Price $1 including postage.

The intention of this directory is to provide a ready trade and technical reference appertaining to all aspects of control, electronics, telecommunications, instruments and automation for use in Australia by Government authorities, industry, commerce, research and educational establishments.

In this first edition, however, some Australian companies have unfortunately been omitted, while in some instances full details of a company's activities were not available and could not be included.

The directory commences with one-page introductions to CETIA and the professional bodies which support it. The first main section lists overseas organisations whose products are marketed by Australian companies. This is in alphabetical order by countries. Then follows a directory of companies with, where available, a resume of products and overseas principals.

A technical editorial deals with eight research projects within the Post Office Research Laboratories in Melbourne.

A 96-page classified directory of products forms a very useful reference, particularly for buyers, enabling a source for any item within the fields of CETIA to be found very quickly. This section will be especially valuable in later editions, when more companies supply the necessary information.

A fuller description of products marketed by 26 companies, two pages describing the activities of Radio Australia, and 13 pages of advertising conclude the directory.

A second edition of this directory will be published to coincide with the 1971 National CETIA Program to be held in Sydney from 15-19 February. It will use a larger format and include an illustrated international section. Any Government or trade authority or company wishing to have full reference is invited to write for details to the Editor, National CETIA Program, Box 3629, G.P.O., Sydney 2001.

In short, a valuable reference which admirably complements the Department of Supply "Directory of the Australian Electronics Industry." (J.H.)

Living with the atom

ATOMIC ENERGY, by Matthew J. Gaines, B.Sc. Published by Paul Hamlyn, London and Sun Books, Melbourne. Colour paperback series, glossy cover, 160 pages 7 x 4 inches, freely illustrated with colour photographs and diagrams. Price in Australia and New Zealand, 99c.

As the cover note points out, atomic energy is playing an increasing, though not always publicised part in our everyday existence but not too many people have much idea of what it is all about. This book should help to modify that situation by providing the reader with a broad coverage of the subject which, for the most part, should prove fairly easy to assimilate.

The first chapter on the nature of the atom and of radiation will probably pose the greatest hurdle, mainly because the author has attempted to compress something that is both complex and basic to what follows into about 13 small pages. It will be a matter for individual readers whether they work systematically from detail to detail or accept it in bulk on the basis of "that's what the man said."

Pages 18 to 75 is a straightforward survey of nuclear power generation in Britain and elsewhere and nuclear propulsion. Here the author is on home ground, being editor of "ATOM" magazine, published by the United Kingdom Atomic Energy Authority.

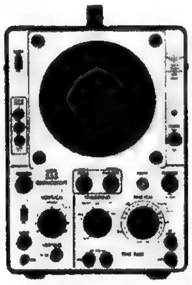
Following sections deal with radioisotopes and their many uses, and the problems of working with radioactive materials. Other sections cover thermonuclear fusion, particle generators and the peaceful uses of nuclear explosions. On the last few pages are brief notes on International nuclear organisation, a table of notable steps in un-

Here are the famous names in INSTRUMENTATION

together with the standard of service to match

A SELECTION FROM THE OUTSTANDING RANGE OF INSTRUMENTS AVAILABLE FROM JACOBY MITCHELL:

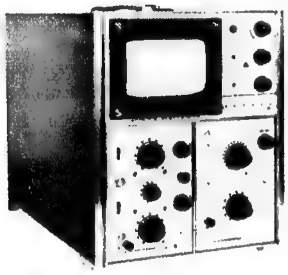
JAYEM



(Right) Model 555 Oscilloscope 5" CRT has 10 x 8 cm viewing. DC—7 MHz (—3dB). 20 mV sensitivity.

[1]

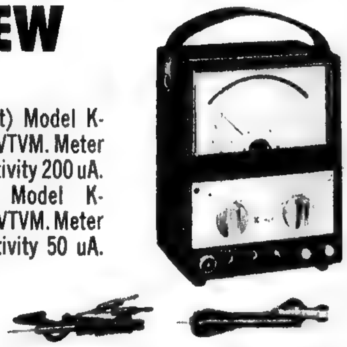
ADVANCE



(Above) Advance OS2000 Oscilloscope. 20 MHz Bandwidth at max. sensitivity of 10 mV/Cm. 10 Cm x 6 Cm display area. Also—OS25 5 MHz Dual Trace Oscilloscope. • B4 RF Signal Generator. Alt. freq. ranges either 100 kc/s to 80 Mc/s or 30 kc/s to 30 Mc/s. • J2E AF Signal Generator. Freq. ranges 15 Hz-50 KHz. • H1E AF Signal Generator. Provides sinusoidal signal from 200 uV to 20V RMS over freq. range 15 Hz to 50 KHz. • SG67 Wide Range Oscillator. 5 freq. ranges covering 10 Hz to 1 MHz. • SG68 Low Distortion Oscillator. Freq. range 1.5 Hz to 150 KHz. • TC11, TC12 15 MHz Timer Counters. TC11 has 4 digit and TC12 5 digit display. • TC9 32 MHz Timer Counter with 6 digit display.

[2]

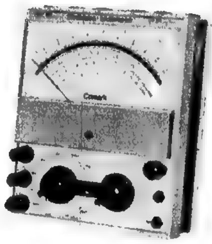
KEW



(Right) Model K-1420 VTVM. Meter sensitivity 200 uA. Also Model K-1400 VTVM. Meter sensitivity 50 uA.

[3]

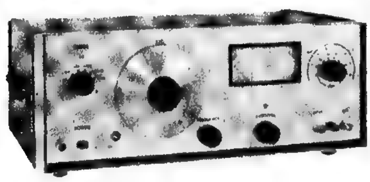
COMARK



(Right) 1200 Series Electronic Multimeter. A range to measure mV, mA, uV, uA, ohms, DC, AC. For portability, lab. or panel mounting.

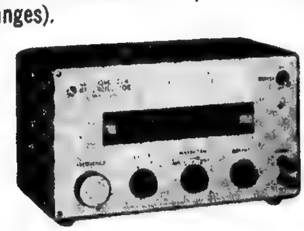
[4]

KIKUSUI



(Above) Model 433 RC Oscillator. Freq. 10 Hz—10 MHz (6 ranges). (Below) Model ORC-27A RC Oscillator. Freq. 18 Hz—200 KHz (4 ranges).

[5]



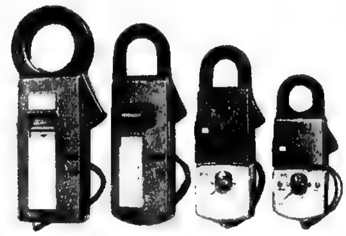
[6]

TAYLOR

(Right) Model 88B Multimeter. Sensitivity 20,000 o.p.v. DC. 2,000 o.p.v. AC. Also— • Model 100 A Multimeter. Sensitivity 100,000 o.p.v. DC, 5,000 o.p.v. AC. • Model 101 Multimeter (slightly modified version of 100 A). • Model 127A Multimeter. Sensitivity 20,000 o.p.v. DC, 1,000 o.p.v. AC.

[7]

KEW



The newest snap-on volt-ohm-ammeters in a full complement of portable rotary scale and swivel case styles that go to 900 amps and 750 volts AC in 8 feature packed models.

[8]

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derstanding the atom, a brief bibliography and a subject index.

A compact and inexpensive little book that should live up to the aims and expectations of its author and publisher. (Just one small point, arising from the caption at the foot of page 17: How can 3 million tons of coal be described as "enough to fill about forty-two 32-ton railway trucks"?) (W.N.W.)

Electronic tests

HANDBOOK OF PRACTICAL ELECTRONIC TESTS AND MEASUREMENTS by John D. Lenk. Published by Prentice Hall Inc., New Jersey, U.S.A. Hard cover, 9in x 6in, 302 pages, line drawings and schematics.

Assuming that the reader is familiar with the use of basic electronic test equipment, this book presents in a straightforward manner the fundamental procedures for testing almost every type of electrical component likely to be encountered in the electronics field. Each procedure described is preceded by a brief description of the 'why' and 'how' of the particular test together with the necessary formulae for the calculation of results.

The early chapters are devoted to particular types of measurement such as voltage, current and resistance with emphasis on the use of basic meter movements and range extension. Later chapters deal with tests applicable to solid state devices, microwave equipment, antennas and transmission lines. In many instances two separate procedures are given for testing, one employing simple equipment for a quick check, the other requiring more elaborate equipment and intended primarily for laboratory work. All theory and mathematical calculations involved are at the 'technician' rather than the 'engineering' level.

The only noticeable omission is any reference to valves or valve testers, the author no doubt assuming that the usual emission or mutual conductance testers require little or no explanation.

In short a useful compilation of handy reference material for both workshop and laboratory. Our copy supplied direct from the publisher who advises Australian release mid-February. Price $15.10. (A.D.N.)

Mathematics

MATHEMATICS by Charles Solomon. Hamlyn all-colour paperback series, published by Sun Books, Melbourne. Stiff paper cover, 160 pages 7 x 4¼ inches, freely illustrated by drawings and charts in colour. Australian price 99c.

The title "Mathematics" could deter many a reader by suggesting hard work, or at least dry-as-dust reading. Aided by Kenneth Ody's full-colour diagrams and sketches, author Charles Solomon has clearly set about to defeat any such impression, once one flips open the pages.

"Mathematics" has not been written for those who learned only "rithmetic" in primary school and who have forgotten most of that. It will however, serve as useful revision for the reader who may well have forgotten a lot of maths but who did come to grips with the subject at the usual secondary school level. He will be reminded of logarithms and once-familiar operations in algebra.

But it is not just a book of revision. It includes a spicing of history and some of the tricky routines and short-cuts which maths masters sometimes demonstrated but never explained!

Some things in the book flow naturally from this approach, including the now vital binary system and a discussion about nothing and infinity. There is a helpful section on probabilities related, appropriately enough, to the probabilities in well known gaming and gambling situations. Another section discusses "How Statistics Can Fool You" while yet another suggests, "What machines can and cannot do."

Glossaries at the back pick up a couple of items which have not been covered elsewhere, and also provide a glossary of terms, perhaps forgotten.

In all, a very good 99c worth for the reader who wants to brush away the cobwebs and up-date a few ideas; this, in a pleasant, easy-to-read fashion. Our copy came from the publishers but the book should be readily available from major booksellers. (W.N.W.)

Standard frequencies

NBS FREQUENCY AND TIME BROADCAST SERVICES. Special Publication 236, 1969 edition. Published by the U.S. National Bureau of Standards. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Paper covers, 7¼in x 10¼in, 14 pages. Price 25c (U.S.)

Detailed descriptions are given of the technical services provided by the NBS radio stations WWV, WWVH, WWVB, and WWVL. These services are: 1, standard radio frequencies; 2, standard audio frequencies; 3, standard musical pitch; 4, standard time intervals; 5, time signals; 6, UT2 corrections; 7, radio propagation forecasts; 8, geophysical alerts. To provide users with the best possible service, occasional changes in schedules are required. This booklet shows the schedules in effect on January 1, 1969.

At its very nominal cost, this publication is good value and should interest not only those who use the services of the NBS stations, whether on a professional or amateur basis, but also those who are merely curious. (J.H.)

Electronics guide

ELECTRONICS GUIDE TO EUROPE, 1969. Published by Noyes Development S.A., 6300 Zug. Schonbuhl 3, Switzerland. Stiff paper covers, 8¼in x 10¼in, 150 pages. Price 85 Swiss francs.

This directory deals exclusively with the electronics industry on a European scale. It contains up-to-date company profiles of over 600 leading electronics manufacturers in the following 14 countries: Austria, Belgium, Denmark, Finland, France, West Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kindgom.

The information has been obtained direct from the companies concerned. The following items are given for each company where available: full name and address; ownership; principal executives; product range; domestic and overseas subsidiaries; plant location; latest sales figures; and number of employees.

To those companies trading with the European electronics industry, this volume should prove a very convenient reference work and assist in planning marketing operations. Our review copy came direct from the publishers. (J.H.)

LITERATURE—in brief

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, N.S.W., 2060, is seeking comment on a draft Australian standard for graphical symbols for logic diagrams, issued as Doc. 1512. This draft establishes symbols for use in logic diagrams representing thought processes or signal flow and control. Although primarily concerned with binary logic for electronic systems, it applies equally well to systems using electrical, pneumatic, hydraulic, or mechanical equipment, or combinations of equipment. Terminology, definitions and general treatment are based on U.S. standards modified in terms of proposals by the Australian Post Office and the Weapons Research Establishment.

Copies of Doc. 1512 may be obtained without charge, from the various offices of the Association in all capital cities and Newcastle. Comment on the provisions of the draft is invited from persons or organisations experienced in the application and use of logic diagrams and should reach the head office of the Association or any branch office not later than May 31, 1970.

THE MICROPHONE, Vol. 5, No. 2, September/October, 1969. Published by the Australian Tape Recording Society, P.O. Box 9, Crow's Nest, N.S.W., 2065. Contents: Editorial; Microview—H.M.V. 8 + 8 modular stereo unit; Audio/visuals; Music broadcasting societies; Audio projects; Trade news; It's all a conspiracy; Renewal prize winners; Recording tape; Tape recorder top ten; Common questions; Hi-Fi dictionary, part 111; Letter; Frequency modulation; Overseas members' supplement; Tape library.

INSTRUMENT INNOVATION: Published by Philips Electrical Pty. Ltd., Test and Measuring Instruments Dept., Box 2703, G.P.O. Sydney, 2001. A short-form catalogue giving brief details of instruments in the following categories: oscilloscopes; counters; pulse generators; LF modular units; recorders; multimeters and voltmeters; professional TV equipment; component testing instruments; radio and TV servicing instruments; microwave components and instruments.

MEASUREMENT METHODS FOR THE SEMICONDUCTOR DEVICE INDUSTRY — A SUMMARY OF NBS ACTIVITY, by W. Murray Bullis. National Bureau of Standards Technical Note 511, issued December, 1969, 24 pages, price 30c (U.S.) Order from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. This brief, illustrated report describes (1) the two projects out of which has grown the present NBS program on Methods for Semiconductor Materials. Process Control, and Devices, and (2) the further activities which were added to meet requirements of the semiconductor industry and the U.S. Department of Defence. A list of references is appended which includes all published results of this work.

PRECISION DC MEASUREMENTS, AN 70. Published by Hewlett-Packard Inc., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. Describes calibration techniques with emphasis on the many problems encountered in such measurements. Calibration terms such as accuracy, repeatability, resolution, and stability are clearly defined. Fundamental techniques of precise DC measurements using four basic instruments are also described.

INVENTUS, Vol. 6, Issue 7, January, 1970. Published by the Inventors' Association of Australia Ltd., Box 3400, G.P.O., Sydney, 2001. Contents: President's corner; New members; Head office and branch reports; Inventors' corner; A.B.C.-TV (Sydney); Brussels International Inventors' Exhibition, 1970; Inventions available for licence or sale; Industrial design council.

TELECOMMUNICATIONS JOURNAL, Vol. 37, No. 2, February, 1970. Published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Contents include: An approach to the efficient use of the frequency spectrum for broadcasting, by Hermann Eden, Institut fur Rundfunktechnik, Hamburg; Problems raised by direct radio communication for satellites, by Professor Eugene Pepin, President of the International Institute of Space Law; Wind finding radar system utilising a digital computer, by P. Griffiths.

Under the heading "Ideas and Achievements," reports are published on: The expansion of the Australian broadband network; an audio-video combining technique developed for satellite use; a new cylindrical lead-acid battery with double the life-span of previous similar batteries.

STANDARDS ASSOCIATION OF AUSTRALIA 80 Arthur Street, North Sydney, N.S.W. 2060, has published revised editions of the following Australian Standards.

AS C1, standard voltages and frequency for AC transmission and distribution systems. The revised standard includes alterations and additions, in the light of overseas practice.

AS C301, standard specification for manual arc-welding electrode holders. This revised edition embraces all types of holders, and includes the current-carrying capacity of the holder, its mechanical strength and a heating test.

Copies of AS C1 and AS C301 may be obtained from the various offices of the Standards Association for 60c and 80c each, respectively.

INDUSTRIAL RESEARCH NEWS, No. 79, January, 1970. Published by the Commonwealth Scientific and Industrial Research Organisation, P.O. Box 89, East Melbourne, Vic. 3002. Contents: World's first large ilmenite upgrading plant likely in Western Australia; Grinding and flotation; Division of Building Research exhibition.

NUCLEAR ELECTRONICS, by Dr Emil Kowalski. Published by Springer-Verlag, Berlin, Heidelberg and New York, 1969. Cloth bound, 8vo, 402 pages with 337 figures. Price DM96 or $26.40 (U.S.). Inquiries to the publishers at 1 Berlin 33, Postfach, Heidelberger Platz 3. A complete and up-to-date monograph dealing with the specialised electronic circuits and instruments used in nuclear radiation metrology. The author describes the various types of radiation detectors with their preamplifiers and auxiliary circuits, following this with a detailed discussion of analog circuits from linear pulse amplifiers to analog computers for pulse amplitudes.

There are two chapters on the various types of analog-to-digital converters, for pulse amplitude or shape, and for time-to-digital conversion. Special nuclear counter circuits are discussed in addition to the fundamentals of digital techniques. Finally, the author reviews the internal circuitry of typical measuring assemblies ranging from simple counters, through multichannel and multi-parameter analysers, to on-line computers.

TECHNICAL NEWS BULLETIN, Vol. 53, No. 10, October, 1969. Published by the National Bureau of Standards. Inquiries to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Contents: Versatile interferometer developed; Joint NBS-SAMA research program; JILA chairman elected; Fluorine studied; Averaging the peak amplitudes of pulses; Post-doctoral research associates; Building-cost systems project; Fluid mechanics building completed; NSRDS news; Standards and calibration; Standard reference materials; Conference and publication briefs; Publications of the National Bureau of Standards.

AN AUTOMATIC METHOD FOR THE MEASUREMENT OF REVERBERATION TIME, by M. E. B. Moffat and N. F. Spring. B.B.C. Engineering Division Monograph No. 80. December, 1969. Orders should be placed with B.B.C. Publications, 35 Marylebone High Street, London, W.1, England. The method includes the making of a special recording which is characteristic of the studio or other room tested. Equipment subsequently selects the required signals from the recording, converts them to digital form, and punches a paper tape describing relevant characteristics of the signals. Reverberation times may then be calculated using suitable computer programs.

ECCO REFLECTOR AND LUNEBERG LENS. Published by Emerson & Cuming Inc., Canton, Mass. 02021, U.S.A. An illustrated folder giving descriptions and application data on the spherical microwave reflectors and lenses offered by the company. An Ecco Reflector is a spherical lens which is converted into a broad, solid viewing angle microwave reflector by the addition of a metallic reflector cap,

the size of which is adjustable. The Ecco Luneberg Lens is a variable dielectric constant device of spherical shape which focuses an incident plane electromagnetic wave to a point near its surface, or conversely produces a plane wave from a point source.

FM DEVIATION: CALIBRATION AND MEASUREMENT BY EDGE COINCIDENCE TECHNIQUES, by M. H. Riches, Grad. I.E.R.E. B.B.C. Engineering Division Monograph No. 79, December, 1969. Orders should be placed with B.B.C. Publications, 35 Marylebone High Street, London W.1, England. A measuring technique is described which enables a deviation meter to be calibrated, using an oscilloscope. This is followed by a method for measuring any given FM deviation on an oscilloscope with the aid of a strobe unit. The principles require that the carrier frequency is low enough for the operation of pulse circuits, and that the deviation to be measured is greater than 10 per cent of the carrier.

NEW IDEAS FROM BISHOP, bulletin 502. Published by Bishop Graphics Inc. U.S.A. Australian agents are: Circuit Components (A'sia) Pty. Ltd., 460 Bexley Road, Bexley, N.S.W. 2207. Describes the latest developments in pressure-sensitive electronic component drafting aids pro-

duced by Bishop. Featured are complete specifications on new connector contact patterns in time-saving continuous strips of up to 880 contacts each. The connector contacts also include a plating bar pattern. Also included is information on Bishop DIP and Flat Pack patterns, including the 8-lead MINIDIP and all lead configureations up to 36.

COMMUNICATION SYSTEMS, No. 4, Published by Marconi Communication Systems Ltd., England, Australian agents: Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents include: Huge new order for earth stations; The new company structure; MARS for NATO; New stamps mark the Post Office transformation; New amplifier for satellite communication earth station; 1000th visitor to radio communication demonstration; Troposcatter systems; Marconi earth stations give top performance figures; Marconi PCM success continues; Piccolo all the way; Hot line across the Gulf; "Hydrus" receiver orders grow.

NEWS BULLETIN, Vol. 3, No. 72. Published by A. F. Bulgin and Co. Ltd., U.K. Australian agents: R. H. Cunningham Pty. Ltd., 608 Collins Street, Melbourne, 3000. Contents include: North Sea drilling; legend indicators; 7-pole plus earth connector; neon signal lamps; standard micro switches; fuse holders; signal lamps.

MULLARD-AUSTRALIA PTY. LTD., 35-43 Clarence Street, Sydney, 2000, has published a pamphlet which repeats the relevant portions of the discussion of "Colour and Colour Reproduction" which originally appeared as Part 3 of a series of articles on Colour Television in Mullard Outlook. The cover of the pamphlet is a reproduction in colour of the chromaticity diagram which appeared on the Jan.-Feb., 1969 issue of Mullard Outlook.

AMATEUR BAND NEWS AND NOTES

I.T.U. Space Communications Conference

Member nations of the International Telecommunication Union, will be meeting at Geneva in June, 1971, to discuss matters associated with Space Radio Communications.

—by Pierce Healy, VK2APQ

The World Administrative Radio Conference for Space Communication, as it is called, has several aspects which will, as far as amateur radio is concerned, be as important as the I.T.U. conferences held in 1959 and 1963. Some officers associated with amateur radio societies in Europe and America go as far as to say that it could be the most important since the Atlantic City conference held in 1947, when the present basis for frequency allocations for the amateur service were set down.

Amateur radio societies, members of the International Amateur Radio Union, are already collating data on the use of frequencies in the VHF-UHF spectrum by amateur operators. Also submissions are being prepared that radio operators in the amateur service be allowed to use sophisticated techniques developed as the result of space research, including those yet to be developed as well as those already in use.

Some details of work being done have been extracted from the Region I News. Other items of interest from societies in Region I have also been included. A map showing all the call areas in that region is on page 165.

Amateur radio societies in the various countries of Region I have been urged to approach their national telecommunications administrations to seek support for the amateur service. The Radio Society of Great Britain and the Swedish Amateur Radio Society (S.S.A.) both report co-operation from their administrations and this will continue during the preparatory work for the 1971 conference.

There has been some degree of liaison between the International Amateur Radio Union headquarters and Region I, while the secretariat of Region III has been in contact with all of the Regions and I.A.R.U. headquarters, suggesting a concerted plan of action to support the cause of the amateur service. At the International Amateur Radio Club convention held in Geneva the opportunity was taken to discuss problems with members of the International Telecommunication Union Secretariat.

Some preliminary views have been expressed from the U.S.A. regarding the amateur use of space communication techniques. This applies to footnote 284A to the table of frequency allocations which reads: — "In the band 144-146MHz, artificial satellites may be used by the amateur service." It is considered that this footnote is unduly restrictive in that it implies that such satellites may not be employed in other bands allocated to the amateur service.

It is suggested that the implied limitation be removed by deleting Footnote 284A and by modifying Footnote number 78 to make it clear that space radio communication techniques may be used in the amateur service within the limitations imposed by the Table of Frequency Allocations (e.g., regional allocations, primary and secondary status).

For example:—

Band 21-21.2GHz: Cancel amateur, add comm. satellite 407.

21.2-22GHz: Cancel amateur 407, add fixed, mobile.

24-24.25GHz: Add amateur 410 on secondary basis to radiolocation.

It must be noted that this is only a preliminary proposal, and could be altered at any time.

THE CALCUTTA KEY

This is the title of an award made annually by the Radio Society of Great Britain for outstanding service to the cause of international friendship through the medium of amateur radio. This year the R.S.G.B. Calcutta Key has been awarded to Rene A. Vanmuysen, ON4VY, who was the leader of the Beligan amateur radio society (U.B.A.) team responsible for the organisation of the 1969 Brussels Conference. ON4VY was also responsible for the first reciprocal licences in Europe, a circumstance that led to the position that exists at the present day.

CALLSIGN PREFIXES

New callsign prefixes allocated recently by the International Telecommunication Union include: A2, Botswana; C2, Nauru; C3, Andorra; 3BA-3BZ, Mauritius; 3CA-3CZ, Equatorial Guinea.

YOUTH SEMINAR

The D.A.R.C., the official amateur radio society in Germany, has a tradition, going back to 1964, of amateur radio youth training seminars. These seminars are usually held in the summer months in youth hostels throughout the German Federal Republic for young amateur radio aspirants.

During a three-week course the students are taught the essentials of telecommunications, Morse code and regulations by volunteer teachers drawn from the ranks of experienced, licensed D.A.R.C. members.

One of the latest of these seminars was held in Plon, Schleswig-Holstein, the northernmost part of the German Federal Republic. At this, the third seminar held at that location, all 28 candidates for the final examination were successful. The examinations were held on the spot by officials of the German Bundespost.

For the duration of the seminar the club station DL0JP was in operation. Other youth seminar stations operating at the same time were:— DL0DNA at Bundheim/Harz, DL0AV, Hessenberg/Wurttemberg and DL0HJ at Dornburg/Hesse.

USABLE FREQUENCIES

The continuing demand for radio spectrum space to meet the needs of commercial organisations is highlighted in an article reprinted from the ICAO Journal in the Region I news. This article gives an insight into the methods used to substantiate claims for specific frequencies to be made available to such organisations.

From Afghanistan to Zambia, with 38 other countries in between, is the record of visits made by ICAO's Frequency Research Units during the past three years to provide much needed technical assistance to Contracting States in finding unused radio frequencies for telecommunications networks.

The rapid expansion of civil aviation flights since the 1950s and the introduction of much faster aircraft have in turn called for a vastly increased civil aviation telecommunications network, and for a very marked reduction in "transit times" for its traffic.

Ideally this traffic should be handled by landlines or submarine cables, but these facilities are not available in many parts of the world, so it is necessary to use radio circuits as an alternative.

The distances involved dictate the use of the high-frequency part of the radio spectrum. Unfortunately, this is an already overcrowded segment of the spectrum since it has also to accommodate a great many other services in addition to those associated with civil aviation: for example, broadcasting, maritime services, Public Service telecommunications and military Services.

Further complicating the problem is the fact that the great increase in the number of independent States coming into being since World War II has resulted in a tremendous increased demand for new transmission channels.

ICAO has in the past received many requests from the developing states for technical assistance in establishing the new links for the civil aviation network. It has been found that in many cases the necessary radio transmitters and receivers have been procured and installed at the circuit terminals, but that it has proved impossible to secure suitable interference-free radio frequencies for the circuits being established.

By 1959, the problem had become so serious that ICAO decided to create a special unit, the Middle East Frequency Unit, to deal with the mounting requests from that region. From the time of its inception demand for the services of the Frequency Unit was constant and grew to

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

such an extent that it was necessary to establish additional units.

At the present time there are three units which undertake assignments in the Middle East and Asia. Africa and Central America; all these units have a continuous backlog of requests for assistance. Each unit consists of an electronic engineer with specialised knowledge and experience in the problems of radio frequency propagation and allocation.

To enable him to carry out the necessary investigation, he is provided with sophisticated radio reception and recording equipment and with regular ionospheric and propagation data from the specialised centres in the world dealing with the subject. Liaison has also been effected with the International Telecommunication Union.

On receipt of a request for assistance. the expert visits one of the terminals of the proposed circuit, where he carries out a theoretical study to determine the ideal frequencies necessary to provide dependable communication on a 24-hour basis throughout the year, taking into account the forecast changes of ionospheric and propagation conditions for several years ahead.

The next step is to relate these idealised frequencies to the world-wide or regional allocation tables issued by the I.T.U., since various segments have been reserved for the different types of services using the high-frequency radio spectrum and new services can only be accommodated in segments reserved for the type of service in question.

Having determined the segments which are suitable from a propagation point of view and which are also acceptable from the point of view on internationally agreed allocations, the next stage is to conduct on-the-spot monitoring; to do this, the radio equipment is set up and the receiver mechanically scanned over the segment chosen. Occupancy is recorded on a paper-tape recorder.

Such monitoring is carried out for several days and subsequently scrutiny of the recorded data will reveal the individual frequencies within the segment which are relatively free from interference, i.e. relatively unoccupied. The service can then be set into one of these quiet spots. It is sometimes necessary to conduct monitoring at both ends of a radio circuit to determine the families of transmitting and receiving frequencies for reliable two-way communication under all diurnal and annual conditions.

THE ASIAN SAFARI

Following my trip to Bombay to attend the First All-India Amateur Radio Convention, then to Delhi and Bangkok as related in the previous two issues of these notes, the journey continued to Hong Kong and Singapore.

On arrival at Hong Kong my first contact was with Lyell Louttit, VS6BE, who also holds the call sign VK2BE. Lyell suggested attending an unofficial get-together of members of the Hong Kong Amateur Radio Transmitting Society at the China Fleet Club. The invitation was accepted, and a pleasant evening was spent discussing many aspects of amateur radio with about 20 members of the H.A.R.T.S. who were present.

The following two evenings of my stay in Hong Kong were spent as the guest of Maurice Caplan, VS6AA, secretary of H.A.R.T.S. and his wife. On both evenings, contact was made with John Lark, VK2ALK, in Sydney. On these evenings local amateurs called in, one of these being Herbert Asmussen, VS6AD. Herbert also has the calls OZ7SM and DJ0SB and is the president of H.A.R.T.S. Roy Chalu, editor of the oriental amateur magazine "OHM," also called in.

A very pleasant day was spent with Lyell, VS6BE, which included a drive to Clearwater Bay, where we were the guests at lunch with Geoff, VS6DA and his family. For those who make contact with Geoff on the air mention of the piece of

PAGES FROM THE PAST

AMATEUR RADIO IN 1921

Included in the family tree of "Electronics Australia" is the journal "Sea, Land and Air," which, among other things, was designated "The Official Journal of the Wireless Institute of Australia and New Zealand." In our files we have Volume IV, covering the period from April, 1921, to March, 1922, from which we have extracted the following interesting snippets.

June, 1921. Extract from the N.S.W. Division Presidential Report for the year 1920-21:

"The matter of transmitting licences has been advanced, and it is hoped that measures contemplated during the next few months will achieve our objective.

"During the past six months repeated efforts have been made to secure a club room, which would be available to members at all times, where buzzer practice could be conducted and meetings held and lectures delivered on topical wireless subjects.

"Our membership during the period has increased from 65 to 75 despite the defection of 8 members, which indicates a matter of 19 new members."

August, 1921. N.S.W. Division, 52nd General Meeting:

"By courtesy of Amalgamated Wireless (Australasia) Ltd., a demonstration of wireless telephony was given under the direction of Mr W. D. Bostock, who went to considerable pains to explain various types of circuits and the evolution of the present day apparatus. By means of a small loop aerial arranged in the lecture room, signals were received from the basement in the nature of gramophone music and speech which was clearly audible throughout the room."

W.A. Division, Presidential address at the Annual General Meeting:

"He stated that since the last Annual General Meeting, the control of wireless telegraphy had been handed over by the Department of the Navy to the Post-master-General's Department. The issue of licences to private individuals was still a burning question. Before the war, both sending and receiving licences were issued. Although the regulations had not been altered, transmitting licences were not now issued, except under very special circumstances."

November, 1921. Wireless Telephone Competition:

"The N.S.W. Division of the W.I.A. is about to conduct a wireless telephone competition among its members. The competition, which is the first of its kind to be held in Australia, is to commence November 13 and will terminate November 18." (Editorial Note: This should have read December 18.)

"(The) competition is to be conducted in the reception of wireless telegraph and telephone signals for all members of the W.I.A., N.S.W. Division."

January, 1922. S.A. Division, Monthly General Meeting:

"A lecture on A Wireless Receiving Station was given by Mr C. E. Ames. (He) explained the different types of aerials, how to obtain a good earth, and also the use of a counterpoise. He explained the construction of Spider Web Inductances and Burndept Coils with condensers for tuning and different methods of mounting these coils."

March, 1922. N.S.W. Division, General Meeting of January 24:

". . .the business of the evening (was) Discussion and Questions on Constructional Details. The speakers discussed the merits of bank-wound coils, flat coils, condenser details, filament rheostats, circuit details, formulas, etc. A simple valve circuit to use both for telephony and telegraphy in conjunction with a 6ft loop aerial on a wavelength of 1,100 metres was also detailed."

---

green wire used as an antenna is a good talking point. During the trip a call was made on Drake, VS6EK.

The inspection of Lyell's, VS6BE, station was a real eye-opener. The equipment installed is like a display of the full range of Collins equipment. His location at an elevation of 2000ft on the Peak at Hong Kong gives him a clear 360-degree getaway. Lyell mainly operates on 15 metres, and in the 144MHz band for local contacts.

This superb location on the Peak is shared with Phil Wight, VS6DR, whom I had the pleasure of meeting. Phil is the foremost DXer in Hong Kong and operates on all bands. One of the main topics of interest at the time was a proposed DXpedition to Spratley Island, set down for the end of January.

My thanks to Maurice, VS6AA; Lyell, VS6BE; Geoff, VS6DA, and the rest of the gang, for pleasant memories of VS6 land.

Singapore was the next stop, after a very pleasant flight from Hong Kong. There I was met by Peter Pang, 9V1AZ, who drove me to my hotel. For the next three days, he was the perfect host, showing me around the city and points of interest around the island. One trip was across the Causeway to Malaysia. Here I met Devan 9M2DD and his wife at their home in Johore Bahru, where I spent a short time discussing amateur radio activities, including the Scout Jamboree-on-the Air.

During my last night in Singapore contact was made from Peter's station 9V1AZ with Alf Seedsman VK3IE in Melbourne and the Christmas Island Radio Club VK9XI.

Then came the trip back home, and I arrived in Sydney on Tuesday morning, January 13, after a very educational and most enjoyable trip. To a very great degree, the enjoyment of the trip was due to the hospitality extended to me by fellow amateur radio operators whom I met during the tour.

VK2AIA HONOURED

YL International Single Sidebanders Incorporated, which was started by a small group of YL operators, and has now grown into an organisation with a membership of 8,000 in 250 different countries, has an award known as the "Top Flight Operator Award." The award, based upon excellent operating procedures, courtesy and awareness is made each month.

The award for December, 1969, was made to (Mrs) Muriel Eagles, VK2AIA of Strathfield, N.S.W. All Australian amateurs will extend their congratulations to Muriel, who is probably the most active of the Australian YL operators. Muriel now has the privilege of voting in the selection of future Top Flight Operators.

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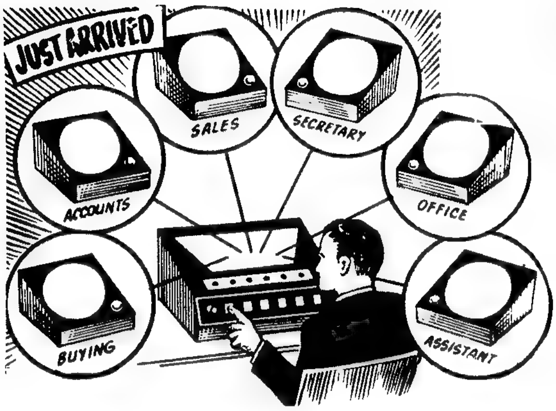

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All prices include Batteries, Cable and Instructions, etc. Postage extra.
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Suitable 5-core Cable 250 yds
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CRYSTAL SET BUILDERS

Coils	80c	Tunings Conds.	$2.00
Diodes	35c	Terms .. .. Ea.	12c
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3in Spools	35c	5¾in x 1,200ft Tape	$3.10
5in Spools	40c	7in x 1,800ft Tape	$5.10
5¾in Spools	70c	5in Plastic Tape, boxes	60c
7in Spools	50c	7in Plastic Tape, boxes	90c
2½in x 100ft Tape	60c	Plus Postage.	
2½in x 300ft Tape	$1.40		
3in x 600ft			

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Metal Plugs	95c	Bakelite ext. sockets	70c
Bakelite	70c	Chassis Jacks	65c

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Capacitor Substitution Box, 1,000 VW .. $5.00
Resistor Substitution Box, 1 Watt, Plus Post, 20c .. $4.50

Michigan/Collard — Four Track Rec./Play Heads .. $21.50
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Michigan/Collard Four Track Erase Heads $8.50

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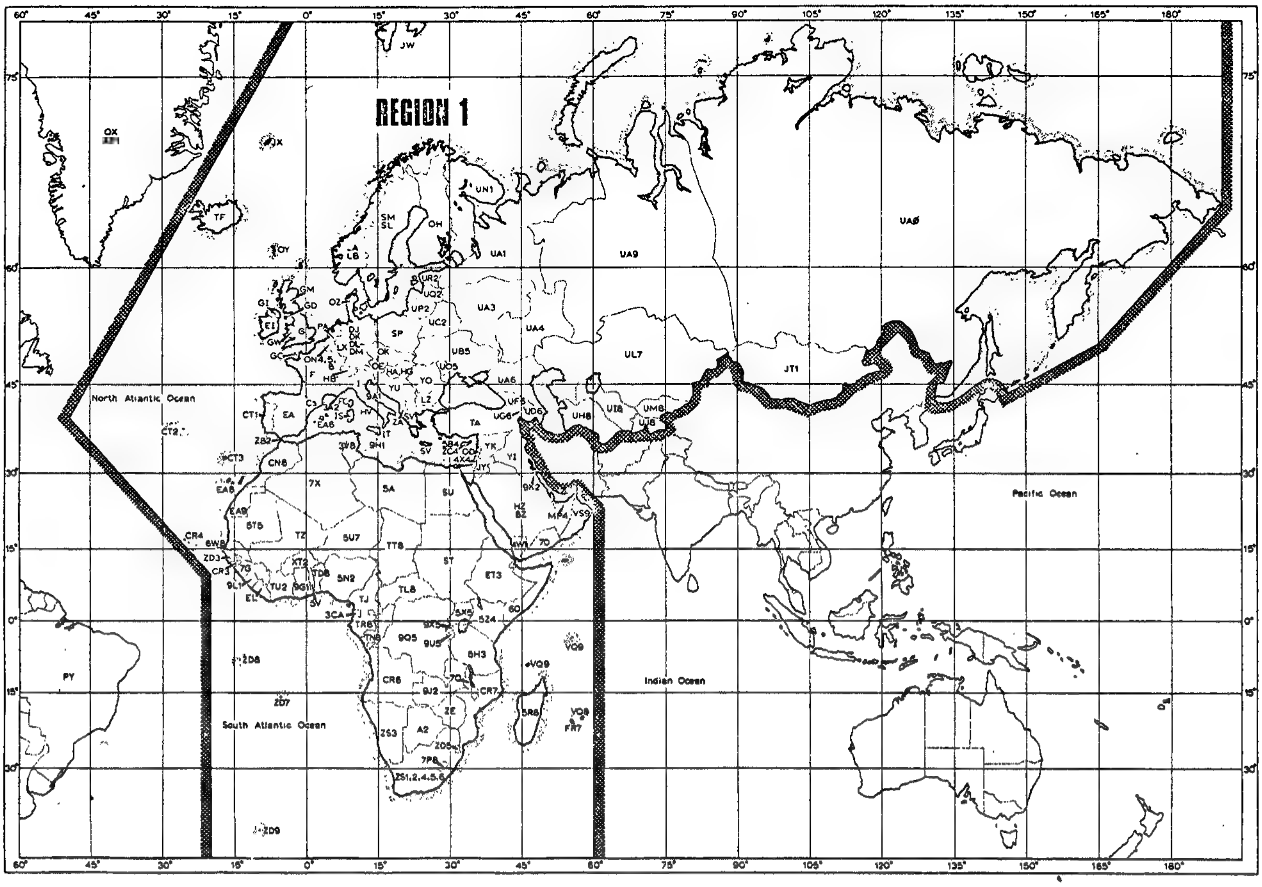


The call areas of Region 1, see page 161.

I.A.R.C. CONVENTION

The Annual Convention of the International Amateur Radio Club held recently in Geneva was opened by Mr R. E. Butler, Deputy Secretary General of the International Telecommunication Union. Prior to taking up his present appointment with the I.T.U., Mr Butler was an officer of the Australian Postmaster-General's Department.

After his opening remarks, Mr Butler spoke of the debt owed to amateurs for their work in developing world communications and for their assistance in times of natural disasters such as floods and fires. He then went on to say:

"If I turn to another aspect, we hear a great deal these days on the development of global communication systems especially in the use of satellites. Again almost unnoticed with their much less elaborate plans, the amateurs have again shown their energy in being to the forefront. You have organised your own satellite experiments which gave many amateurs the possibility of joining in the use of this new technology. With the orbits which were selected there has been more or less global use of the satellites."

FIRST ALL-INDIA AMATEUR RADIO CONVENTION

The Official Report of the First All-India Amateur Radio Convention was received as this issue was going to Press, and will be the main feature of these notes in the May issue. As previously reported, our Amateur Correspondent Pierce Healy, VK2APQ, attended the Convention as an official guest.

U.S.A. AWARD

The Five Band Worked All States Award is to be issued to those who obtain confirmed contacts with all 50 U.S.A. States on five bands after December 31, 1969. It will be issued in addition to the normal WAS Award. There will be no mode endorsements issued, and cross mode or cross band contacts will not be counted.

A special application form will be available from A.R.R.L. headquarters, and the sum of $10 (U.S.) which is charged for the award will cover the cost of the special plaque and return of the 500 QSLs by first-class registered mail. Only written QSL confirmations will be accepted and no credit will be given for confirmations via contest logs.

The 5BWAS is available to all amateurs, but applicants in the U.S.A., Canada, Peurto Rico and U.S.A. overseas territories must be full A.R.R.L. members.

This award should prove to be a challenge to operators throughout the world.

SCOUTS' H.Q. STATION

The Queensland branch, Boy Scouts, headquarters amateur radio club station played an important part during the opening of the new Club and Scout activities area at the headquarters camping site, Samford, 12 miles west of Brisbane. On Sunday, February 22, an official ceremony was held to mark the opening of new buildings recently erected on the site at a cost of $23,000. These include a swimming pool and a new building to accommodate the radio station previously installed at the branch headquarters in Brisbane, which had experienced many difficulties due to electrical interference in the city area.

The new site has been described as a radio operator's dream with virtually no QRM, and excellent contacts have been recorded. The station is equipped with a Swan 350 transceiver and a G5RV antenna. Plans are to install a tri-band beam antenna in the near future.

The station will provide facilities for an electronics workshop to assist those interested in amateur radio and other aspects in that field. It will also play a part in the organising and conduct of future activities at the camp site. One of these projects is a monthly get-together on the fourth Sunday of each month with other Australian Scout group radio clubs. At the present time there are five Scout clubs in Queensland, four in New South Wales, two in South Australia and one each in Victoria, Tasmania and Western Australia.

Operating times for the information of clubs and amateur operators interested in the Scouting movement are 0900EST to 1200EST and 1400EST to 1700EST. Transmissions will be on 7.1MHz until 1030EST and 14.120MHz for the remainder of the operating periods. The call sign is VK4QH. The operators will be pleased to contact any amateur station in Australia or overseas.

Noel Lynch, national organiser for the Boy Scouts' Jamboree-on-the-Air, expresses appreciation on behalf of the operators for the excellent co-operation received from those who passed on best wishes to the station on Founders' Day.

W.I.A. ACTIVITIES

The delay in mail deliveries has resulted in no interstate news being received in time for inclusion in these notes.

The Captain James Cook Bi-Centenary Award has proved a very propular activity. Many overseas operators have already lodged application for the certificate. To be eligible for the award, overseas stations are required to contact 50 Australian stations using the special "AX" prefix. In making applications for the award it is not necessary to submit QSL cards as proof of contact. However, a certified copy of extracts from the station log must be sent.

Australian stations are required to make contact with 100 stations using the 'AX' prefix in he following ratio of call areas: "AX1-3; AX2-30; AX3-30; AX4-11; AX5-11; AX6-6; AX7-4; AX8-1; AX9-3; AX0-1.

All applications must be sent to:

Awards Manager, W.I.A.
P.O. Box 67,
East Melbourne, Victoria 3002.
Australia.

NEW SOUTH WALES

The Central Coast Branch of the New South Wales Division held their annual field day at Gosford Show Ground on Sunday March 1. Amateur call signs registered totalled 172, and the grand total of those who attended was 350.

Field events were conducted both on HF and VHF bands and were keenly contested, while the quiz competititons had the participants thinking deeply.

The ladies catering committee did an excellent job in providing a hot midday meal as well as morning and afternoon tea.

Trade displays by W.F.S. Electronics, Sideband Electronics Engineering and Bail Electronic Services created quite some interest in the latest trends in commercial equipment.

Overseas visitors were "Soupy" Groves, W5NW, and his wife Elizabeth, W5DUR, from Texas, U.S.A. who are on a tour of the Pacific countries.

Excellent prizes donated by the trade houses were presented to the successful contestants.

UHF/VHF RECORDS

The Australian UHF distance record on 1296MHz, reported in the February issue of these notes, was relatively short-lived. The distance of 149 miles has been bettered by a contact between Ron Wilkinson, VK3AKC, located at Geelong, Victoria, and Wilf Emmett, VK7WF, located in Burnie, Tasmania, the distance being 223 miles across Bass Strait.

This contact was the culmination of tests extending over a period of about four months, during which time CW signals had been heard at both locations. Two-way phone contact was established, with signals peaking readability 5; signal strength was 8 both ways at about 1800EST on Thursday evening, February 5.

However, again the record was to be short-lived, because a few hours later Kevin Bond, VK3ZKB, located at Nunawading, some 25 miles north of VK3AKC at Geelong, established contact with VK7WF over a distance of approximately 250 miles. Signal reports exchanged during this contact were: VK3ZKB, readability 5, signal strength 7; VK7WF, readability 4, signal strength 5.

A brief summary of the equipment used is: —

VK3AKC. Transmitter: radial cavity 2C39 tripler, power output 3 watts. Antenna: 7ft diameter dish, slot-fed dipole about 40ft high. Receiver: diode mixer converter—144MHz IF.

VK3ZKB. Transmitter: solid state to 144MHz, MA4060 to 432MHz, UHF transistor base-collector junction as a varactor. Power output about 3W. Antenna: 4ft dish, 30ft high. Receiver: Cs2 mixer diode,

THE ORIENT AWARD

From January 1, 1970, the Orient Award will become available to amateurs throughout the world. This award will be made to licensed amateurs who obtain the required number of points by making two-way contact with stations as specified in the Orient Award Countries List.

The rules for the award are as follows:—

1. The award is issued in 3 classes, Class I, Class II and Class III. Each class will be issued to the applicant according to the number of points contained in his application. These points will be calculated according to the table in paragraph 4. The minimum points required for qualification are:

   Class I — Orient Stations — 150 points; others — 120 points.

   Class II — Orient Stations — 100 points; others — 80 points.

   Class III — Orient Stations — 75 points; others — 60 points.

"Orient Stations" are those located in countries which appear in the Orient Award Countries List.

2. Endorsements for the award are issued in three categories:

   a. Two-way CW.

   b. Two-way phone.

   c. Mixed.

3. Applications for the award must contain proof of two-way contact. In the case of Class II or Class III applications, the proof may consist of a check list signed by two officers of the applicant's local or national society. Applications for Class I must consist of QSL cards and must be accompanied by sufficient postage for their return. Official application forms are available upon request.

4. Points are to be calculated as follows:

   For contacts on 28MHz, 21MHz and 14MHz — 1 point per contact.

   For contacts on 7MHz — 2 points per contact.

   For contacts on 3.5MHz — 3 points per contact.

An applicant who contacts a station on five bands will receive a bonus of 5 points, in addition to the points earned for individual contacts.

5. Applicants may claim only one station in each country on each band for points towards the award.

6. Only contacts with fixed or mobile land stations will count towards the award.

7. Only contacts made after January 1, 1970, will count toward the award.

8. Only contacts with stations acceptable by the A.R.R.L. for D.X.C.C. confirmation will be acceptable for the Orient Award.

9. Applicants must include 10 IRCs or $1 (U.S.) when applying for Class II or Class III award, or 50 IRCs or $5 (U.S.) when applying for Class 1 award. These should be sent to the Awards Manager, P.O. Box 16321, Hong Kong.

Recipients of Class II and Class III awards will receive an attractive certificate suitable for framing. Class I award will be a teakwood and bronze plaque, hand engraved.

SPECIAL NOTE: The first station to receive the Class I Orient Award will receive a special plaque, lacquered, with pearl inlay, hand made by Hong Kong's leading jewellery makers.

Orient Award Countries List

AC3—Sikkim	JT—Mongolia	VU4—Laccadive Islands
AC4—Tibet	KR6, KR8—Ryuku Islands.	VU5—Andaman Islands
AC5—Bhutan	UA9, UW9—Asiatic USSR	XU—Cambodia
AP—East Pakistan	UA0—Asiatic USSR	XV5—Vietnam
AP—West Pakistan	UJ8—Tadzhik	XW8—Laos
BV—Taiwan	UL7—Kazakh	XZ2—Burma
BY—China	UM8—Kirghiz	YA—Afghanistan
CR9—Macao	VS6—Hong Kong	4S7—Ceylon
HS—Thailand	VU2—India	9M2—West Malaysia
HL, HM—Korea		9N1—Nepal
JA, JH, KA—Japan		9V1—Singapore

70MHz first IF, 2.4MHz second IF to a tunable receiver.

VK7WF. Transmitter: 144MHz SSB with carrier reinserted into varactor triplers to 1296MHz. Antenna: 7ft dish.

On Sunday, February 1, the 432MHz Australian distance record was broken when Peter Collins, VK3ZYO, of South Oakleigh, Victoria, made contact with Tony Bell, VK5ZDY, located at Stirling, South Australia, increasing the distance from 402 miles to 410 miles. Signals were readability 5 and strength 9 both ways.

It is understood that this record also was short-lived, as Ray Naughton, VK3ATN, located at Birchip, in northern Victoria, made contact with Wilf Emmett, VK7WF, in Burnie, Tasmania, increasing the distance to 430 miles. Details of the equipment used, time and signal reports have not yet been received.

Record-making contacts on 144MHz were established on Sunday, February 1, with the first-ever contact between VK3 and VK6 call areas. At 0955EST, Bob Halligan, VK3AOT, from Mount Waverley, near Melbourne, worked Bernie Gates, VK6KJ, of Albany, Western Australia, with signals at readability 5, signal strength 4 both ways.

Later VK6KJ was worked by Geoff Wilson, VK3AMK, in Frankston, Ray Naughton, VK3ATN, Birchip, and Sid Bryant, VK3CI, Nagambie, northern Victoria. The distance of 1,600 miles between VK6KJ and VK3CI set a new VK6 record, but the VK3 record still stands.

The details of this remarkable set of contacts were received by Peter Carter, VK2ZPC, in letters from Bob Halligan, VK3AOT, and Peter Collins, VK3ZYO.

YOUTH RADIO CLUB SCHEME

MAITLAND RADIO CLUB: One of the highlights of the club's activities during February was the presentation of certificates to members who have been successful in the recent Youth Radio Club Scheme examinations. Mr E. E. Gray, the area director of Education, who was unable to attend due to ill health, was represented by the Maitland District Inspector of Schools, Mr H. Morgan. More than 50 members and friends were present at the club rooms for the function. Members have responded to the call for instructors and seven different classes are now conducted each week.

A tribute to the work being done by the club was given in an editorial in the Maitland newspaper, "The Mercury," on Tuesday, January 20, 1970.

CAMP TECHNOLOGY 1969-70

In order to accommodate the many young people interested in attending the 1969-70 Camp Technology Series, three camps were held (junior, intermediate and senior) catering for High school pupils from 1st to 6th form. There was a record attendance of 160 officers and campers, including a number of girls at the senior camp. The latter was an experiment, but results have convinced the organisers that future senior camps should be co-ed.

This year saw the building of two FM radio-controlled cars, the completion and successful operation of a foot pedal bass register for an electronic organ, as well as the usual interest in electronic gadgets, transistor experiments, Y.R.C.S. classes, photography and the Camp's amateur radio station, VK2BCT.

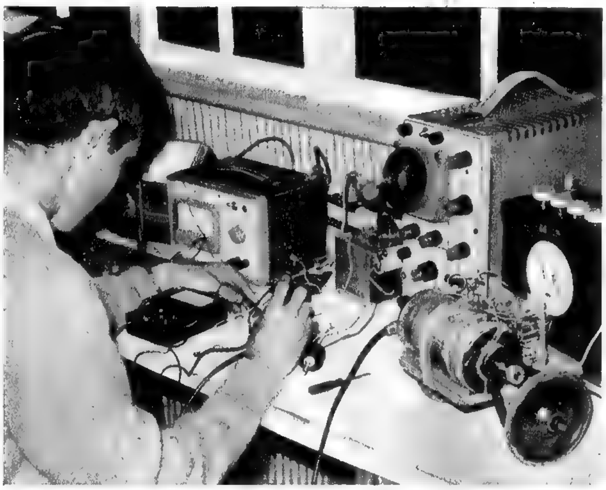
Camp Technology is sponsored by the I.S.C.P. (Inter School Christian Fellowship). It received the 1968 I.R.E.E. Award for its contribution to youth work over the years. Camp Technology has got off to a good start in South Australia and Tasmania, the latter camp receiving a comment in a recent issue of "Amateur Radio."

The technological aspect of the scheme is a worthwhile end in itself. Numbers of past campers have commenced tertiary technical training or are training in industry. Three of this year's campers have now passed the A.O.C.P. examination and have their full amateur licence, while well over 100 boys have gained various Y.R.C.S. awards.

The organisers emphasise that the camp caters for anyone interested in electronics or photography regardless of previous experience. Beginners in every age group will be warmly welcomed at the 1970/71 series of camps. Any person attending a State or private High school is eligible.

For further information contact Mrs P. Mayne, 16 St. Aidan Avenue, Dundas, N.S.W. 2117, phone Sydney 630-2463.

Camp Technology's amateur radio station.



Construction of a radio-controlled car.

A VHF outing.

Home-made rotator and beam with the "Grange," home of the camp, in the foreground.

TUDOR RADIO

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ESTABLISHED 1940

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PHONE 51-1011

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Knobs for concentric shaft. Dozen **$1.20**
250 mixed screws. BA, Whit., self-tapper bolts, nuts, etc. **$1** bag plus **25c** post.
Crystal microphones, good quality, ideal tape recorders, etc. **$2.80.**
Transistor speaker transformers, single ended, 5 watt. **$1.50.**
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MSP 12-inch dual cone	**$8.50**
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Rola 6 x 4 15 ohm	**$3.50**
Rola 5 x 3 15 or 27 ohm	**$2.50**
MSP 6 x 9 15 ohm	**$5.00**
3-inch single cone 15 ohm	**$4.20**
6 x 4 33 ohm	**$3.00**
MSP 20 Watt	**$19.75**
MSP 12-inch 8 ohm	**$8.50**
MSP 2-inch 15 ohm	**$2.00**
MSP 8-inch dual cone, 8 ohm	**$6.50**
MSP 12-inch-3.5 ohm	**$6.00**
MSP 4-inch large magnet 8 ohm	**$2.50**
MSP 3-inch 150 ohm	**$2.50**
MSP 3-inch 15 ohm	**$3.00**
National 8-inch built-in tweeter and crossover network	**$12.75**

MSP Electro Dynamic, 8in, **$4,** or 6 x 9.
MSP 6 x 2 15 ohm, **$3.**
MSP 6 x 4 15 ohm, **$3.50.**

Peak 6o7 16 cm Hi-Fi Dual Tone 6in	**$7.50**
MSP 20-watt radial beam 12pqb	**$21.50**
Magnavox 8 ohm 4in tweeter	**$2.50**
2 gang tuning condenser	**$1.00**
Peak H50 horn type tweeter	**$12**
MSP 8-inch speakers	**$4**
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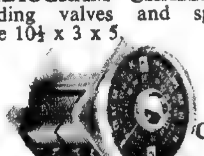
SPEAKER CABINETS complete with radial beam MSP 20 watt speaker and horn type tweeter with cross over network .... **$70 each**
Solid oiled teak 23½ x 17 x 12.

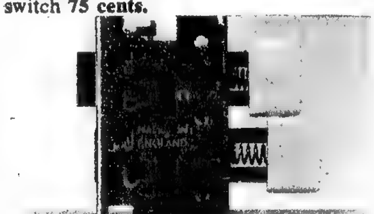
RADIOGRAM CHASSIS 4 valve including valves and speaker, **$15.50.** Size 10½ x 3 x 5.



SMALL 2-GANG TUNING CONDENSERS

Complete with direct drive scale **$1.75**
TV IF STRIPS .. .. **$5** each.

ENGLISH PANEL LAMP with toggle switch **75 cents.**



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Curled expanding shielded wire approx. 7 yards **$1.50**

Miniature valve sockets 7 and 9 pin **15 cents** each.
Speaker Crossover network Condensers 2 MFD — **60 cents.**
Philips IFT's 455KC ...... **75c each**
Aerial and oscillator coils .. **50c each**

Transistors 2Niio	**40c**
Silicon diodes HR	**50c**
OA diodes	**40c**
OA Diodes	**40c**

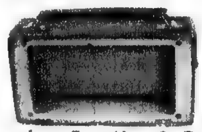
Transistor IFs, medium size, **75c each**

PORTABLE PHILIPS RECORD PLAYER
$7.75 6 Volts.

Speaker transformers 15,000 and 25,000 to 3 ohms 6 watts .... **$1.50** each
5,000 to 3 and 15 ohms .. **$1.25** each
Transistor speaker chokes **$1.50** each

POTS

1 meg. 2 pole switch	**95c**
100K switch 2 pole log	**50c**
10K carbon or wire wound	**50c**
1.5 linear	**50c**
½meg log	**50c**
½meg switch 2 pole 1 in	**50c**
20K switch	**75c**
10K switch	**75c**
1.5 dual ganged log	**$1.00**
0.25 dual ganged log	**50c**
Dual 3 meg ganged log	**$1.00**
500 ohm WW	**50c**
50K Lin	**50c**
15K T5K	**50c**
Dual ganged concentic 2 meg log 2 pol	**$1.25**
7.500 log	**50c**
200K lin	**50c**
250K log	**50c**
2K lin slotted	**25c**
50 ohm	**50c**
250K lin	**50c**
100K lin	**50c**
½meg lin	**50c**
50 log switch	**75c**
1 meg dual ganged log	**$1.25**
2 meg lin	**50c**



Transistor case, leather, 7 x 4½ x 3. Pack and post 30c.

STEREO AMPLIFIER KIT SETS

TU 10, 3.5 watt per channel .. **$19**
TU 11, 3.5 watt per channel, has facilities for tape and microphone channels **$23**
TU 12, 5 watt per channel .. **$22.00**
TU 13, 5 watt per channel, with TU 11 facilities **$27**
Each kit set includes valves and all components. Front face plate, if required, **$1** extra.
Single stage amplifier kit set:
5 watt per channel **$22.00**
Transistor ear plugs .. .. 3 for **$1.00**
Tag strips, mixed types .. Dozen, **60c**
Switches, oak 4 position .. **50c** each
2 position .. .. **40c** each

3½ AMP. FUSES $3.50 100.

Din Plugs, 3 or 5 pin .. .. 50c each.

ELECTROS:

3 in one

50	250	415
8	350	415
10	350	415

75 cents each.

SOLID STATE AMPLIFIER WITH TUNER
8 watts per channel **$65** pack and post $1.

SOLID STATE STEREO TAPE RECORDER
Oki 300 10 transistor **$130** pack and post $1.50.

HITACHI FM AM SOLID STATE STEREOGRAM
16 watts per channel magnetic cartridge balanced tone arm cost **$225** sell **$225.**

B.S.R. 4-SPEED GRAMOPHONE MOTOR AND PICK-UP $12.50.
Pack and Post 60 cents.

METAL RECTIFIER, 150 watt, ¼ amp, **$1 each.**

All types **$3.50** to **$20.00** plus post.
TV aerial lead in .. .. .. **10c** yard
Tuning Condensers, 2 gang or 3 gang —**$1** each.

2 amp fuses .. .. .. **$3.50** per 100
Special, 12in speaker, 2 ohm Rola, **$6.00** pack and post, **75c.**
Transistor plastic outer case, **50c** each
Transistor carrying straps .. **20c** each
Stereo pick-up arms, with Xtal, **$6.00** ea.
Metal rectifiers for battery and electric portables .. .. **50c** each, post **10c**
Pilot lamp holders .. .. **60c** per doz.
TV or cabinet castors .. 4 for **$1.00**
100 Mixed Knobs including TV channel changers **$10.00**
3½ amp Fuses .. .. .. **$3.50** per 100
10 for **50c**

AMPLIFIERS SOLID STATE
8 watts R.M.S. per Channel .. **$65.00**

STEREOGRAM CHASSIS
7 valve microphone and tape recorder connections **$50.00**

OA 70 diodes .. .. **40c ea.**
Morganite and IRC resistors. At least 33 values. Suit transistors, radios, TV etc., **$2.00** per 100. Pack and post, **25c.**
3, 5, and 10 Watt IRC wire wound resistors. Many values.
20c each, 12 for **$2.00**
100 mixed condensers, micas, ceramics. tubular. Fresh stock.
$2.00. Pack and post **25c.**
50 + 24, 350 vw + 100 mf 25 vw, **75c** each
30, 30mf 300 vw 350vp .. **75c** each
Many others. Invaluable for service.

2 meg. Lin Pots **50c**
R.C.A. 7 INCH TAPE SPOOLS 75 cents

ALPHA 200VAC ½ amp push-on switches, **30c** each. Ideal for fridges.
90 deg. PICTURE TUBE SOCKETS **25c** each. 152 valve sockets, **25c** each.
Transistors AC127, 2N384, 2N217, 2N218, OC71, OC75.
$1.00 each. Post and pack **5c.**

Electros 1.8 x 0. 9 MF — 20c each

AUDIO TRANSFORMERS
18-4294, 28-4536 .. .. **75 cents each**

PILOT LIGHTS, Plug in .. **10 cents**

SWITCH WAFERS
20 cents each.

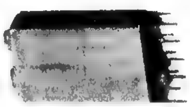
B.S.R. Record Changers Ua 25.	**$25.00**
B.S.R. UA 70	**$40.00**
B.S.R.MA 75	**$50.00**
Garrard at	**$50.00**
Elac	**$25.00**

TRANSISTOR speaker and Case, Plastic, 5-inch speaker with plug and lead, **$4** each. Pack and Post 25 cents.

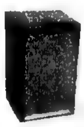
Stereo Head Phones, good quality, **$9.00**
Discatron chassis **$2.50**

NEW VALVES

12AU7	$1.25	SSJ7	$1.25
6SA7	$1.25	6BH5	—
6BU8	$1.25	6D6	$2.00
6BM8	$1.50	EL33A	$2.00
1S5	$1.00	6B4	$2.00
6BE6	$1.25	17Z3	$1.50
6SH7	75c	QVO4-7	$2.00
6CJ6	$1.50	1954	$2.00
6L18	$1.00	12AX4	
ECL85	$1.25	G.T.B.	$1.50
SP61	$1.00	9A8	$1.50
UU9	$1.00	6W6	$1.50
12BE6	$1.00	6ACT	—
6AU4	$1.25	12AN7	$1.25
6U9	$1.25	12AH8	—
6Y9	$1.25	6ES6	—
6X9	$1.25	6N7	—
6AQ5	$1.25	6DA6	—
1B3	$1.50	6CJ6	$1.50
1S2	$1.50	6T8A	—
5AS4	$1.25	UL84	$1.50
6DQ6	$1.50	EL81	$1.50
12AT7	$1.25	EF39	—
12Ax7	$1.75	6CH5	$1.25
6B8	$1.25	17 BFH	$1.50
6CH6	—	6BX7	$1.25
6AU5	—	12FR8	$1.00
6SL7	—	6CK5	$1.25
6BW8	—	3OAE3	$1.50
6DC8	—	6AH4	$1.25
6CK6	—	UCL82	$2.00
6V9	—	6JN8	$1.25
6BH8	—	EF41	$1.50
35W4	—	50EH5	$1.50
6BC8	—	6CD8	$1.25
PCL81	$2.50	25Z5	$1.50
12AH8	$1.25	UF 41	$1.50
6DC8	—	7AN7	$1.50
6BN4	—	UF 41	$1.50
PCL83	$2.00	X148	$1.50
12FX8A	$1.50	EY86	$1.50
6DS8	$1.25	6BA8	$1.50
9U8	$1.25	PCC 85	$1.50
ECH 42	$1.25	15A6	$1.50
6ET6	$1.25	Z759	$1.50
1AR11	$2.50	EY 51	—
6DJ8	$1.50	1U4	$1.00
7FC7	$1.50	6DB5	$1.25
UY 85	$1.50	PCF 80	$1.25
12AQ5	$1.25	6S2	$1.25
12AV6	—	23Z9	$1.50
6BD7	$1.25	EF6	$1.25
6AM8	—	6AM5	$1.25
6AT6	—	EM85	$1.25
ECH35	$2.00	EA50	$1.25



TV IF COILS, IDEAL FOR COIL FORMERS . . . . **$1 dozen**



SPEAKER CABINETS

13 x 6½	$5.00
10 x 6 x 4½	$3.50
12½ x 8½ x 6	$5.00

Fuse holders . . . . . . 50 cents dozen
Octal valve sockets . . 50 cents dozen
Chokes 18 Henry 30 mill **$1.50**

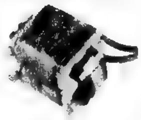
M.S.P. 6in SPEAKERS, 3 or 15Ohm **$4.00**

Car radio push button tuner . . **$4.50**
Pack and post 30c, Interstate 60c.

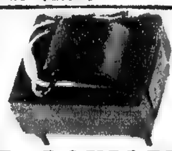
DIAL DRUMS, 5 inch, 3½, 3¾, **50c ea.**

ELECTROS 20 MFD 200 P.V. . . **20c**

TV POWER TRANSFORMER, $8. 300 mil. Two 6.3 windings, 200 volt secondary for Bridge Type Rectifier.

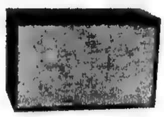


50 M CHOKE $1.
Pack and Post 30 cents,
Interstate 60 cents.
300M Choke $2.50.



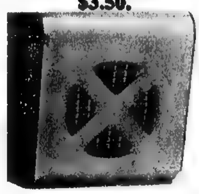
VOLTAGE DOUBLER POWER TRANSFORMER. 200 mil 240 volt x 105-110 secondary 6.3V 15 amp . . **$8**

BATTERY SAVER, 6 or 9 volt DC 100MA **$8.50;** 300MA, **$10.00.**

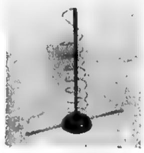


SPEAKER ENCLOSURE, complete with 8in M.S.P. dual-cone speaker, 8 or 15 ohm **$15.80**
Cabinet without speaker **$10**
Cabinet size 16 x 10 x 8.

TRANSISTOR EXTENSION CABINETS
Complete with 5-inch speaker and lead. **$3.50.**



TRANSISTORS
2N1110 . . . . 40c



INDOOR TV AERIALS $1.50.
Pack and Post 25c.

STEREO AMPLIFIER 10 watts per channel solid state AT6 Garrard record changer, oiled teak cabinet, complete unit **$125**
Same unit with Garrard 3000 changer, **$115.**

TAPE RECORDER COUNTERS $1.75

POTS
1 meg. Dual Ganged Log **$1.25**
1 meg. Dual Ganged Lin **$1.25**
½ meg. Switch Pot double pole log **75c**

6 VOLT PILOT LIGHT, screw in . . . . **ea. 10c**

RESIN CORE SOLDER 5 yards 75c

N.E.C. Cassette tape recorder cost $89. Sell new **$59.00**

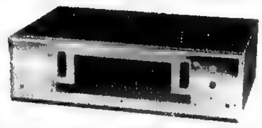
Tab pots 500 ohm 1in . . . . . . **20c ea**

Electrolytic Capacitors
8MFD 450 WK 550 surge. **4 for $1.00**

AMPLIFIER OR TUNER CABINETS, oiled teak 10½ x 5½ x 3 . . . . **$2 each**
Pack and Post, 30 cents.
Interstate 60 cents.

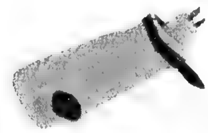
Ducon 2 pole dual concentric switch pots log 500K CT 100K 1 meg **75c**

STEREO SPEAKER LEAD, 10 cents yd.

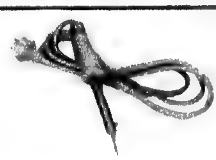


DISCATRON CABINETS $2 EACH.

2N [illegible], 2N 1110, 2N 1111. Transis-to[illegible] . . . . **50 cents each**



GARRARD PLUG IN STEREO CARTRIDGE, $6.00



ROBINSON SOLDERING IRONS, 30 WATT **$6.00**
40 watts **$6.00**
60 watts **$6.25**

2 ONLY TRADED-IN STEREO AMPLIFIERS, $18 each.
3½ watts per channel.

Speaker Cabinets size 10 x 7 x 4½. **$3.50**

Pots 50 ohm switch . . **50 cents each.**

American or Japanese 2 pin power plugs rubber complete with 2½ yards flex **50 cents. Pack and post 10 cents.**

MICROPHONES MAGNETIC OR CRYSTAL **$1.75**

SPEAKER CABINET, 16 x 10 x 8, complete with 6 inch M.S.P. dual cone Speaker tweeter, 3 inch and Crossover network **$18.75**

MAGNAVOX 8 WR, 10 WR 12 WR.
Tweeter 3, 4 or 5 inch.

Speaker Plugs, 4 pin . . . . . . **15 cents**
Speaker Sockets . . . . **15 cents**

RADIOGRAM CHASSIS STEREO
Complete with valves 3½ watts per channel **$25**

POWER TRANSFORMERS
100 mil 6.3 . . . . **$5.00**
30 mil 6.3 . . . . **$2.50**

MSP 6 inch dual. cone — **$.50** each.
MSP 3 inch tweeter — **$3.75.**

MULLARD BOOKSHELF SPEAKER CABINETS, $10 each.

STEREOGRAM CHASSIS, 5 watt per channel, complete except speakers, **$35.**

THREE WATT AMPLIFIERS,
complete with speaker.
NEW. $10.00.

NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 $18.00 Postage 50c

20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

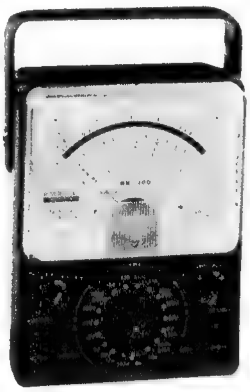
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-100 $39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: **0.6, 3, 12, 60, 300, 600, 1200V (100,000Ω/V)**

AC Volts: **6, 30, 120, 300, 1200V (10,000 Ω/V)**

DC Current: **12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.**

Resistance: **20KΩ, 200KΩ, 2MΩ, 20MΩ**

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

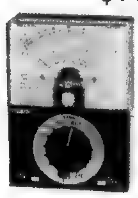
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

NEW TYPE Y-3 MULTIMETER

MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1⅜".

Checked, Packed and Posted — $9.50. Limited Stocks.

"HANDYMAN" RH 150 $11.50



CHECKED PACKED & POSTED FREE

Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS

DC Volts 2½, 10, 50, 250, 1000.
AC Volts 10, 50, 250, 500, 1000.
DC Current, .1, 25, 250 M/amps.
Resistance, 20K and 2 megohms.
Decibels, —20db = +62db .7K/c.
Capacitance, .0001, .01, .0025, .25 mfd.

Model RH-20 $15.00 Postage 50c

20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

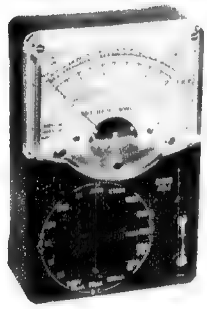
DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

Model RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

Model RH-60 $25.00 Postage 50c

50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

Models RH-20, -55, -60 are:—

● Overload-protected by dual silicon diodes ● Mirror scale ● Double-jewelled ±2% meter ● ±1% temperature-stabilised film resistors.

NOTICE

The Royal Arcade Branch shop has been closed during rebuilding. Enquiries 26-3846.

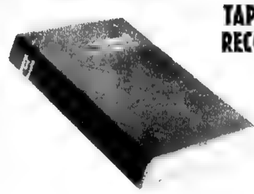
NEW FOR 1970 —

digital electric alarm clock, **$19.75.**

Crystal radios, **$3.95,**

Six transistor pocket radios, **$11.75,** and seven transistor micro-radios, **$39.75.**

TAPE RECORDER



$20.50

BOOK TYPE

The latest model portable Tape-recorder. 4 transistor, 3in reels, 2 tracks. Instruction manual. Size 10½in x 7in x 1½in.

Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price, **$20.50, posted anywhere.**

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

LISTENING AROUND THE WORLD

Radio North Sea in operation

Good reception has been observed in New Zealand of Radio North Sea International, the first off-shore broadcaster to use short wave. The vessel is located off the Belgian coast.

by Arthur Cushen

The reception of Radio North Sea International was first noted during its test transmissions on 6210KHz from opening at 0500 to fade out after 0830GMT. For the initial three days of test broadcasting, only German and Dutch announcements were heard but then English was added. These announcements included one which gave the frequencies and another with the address for reception reports and the third gave details of the schedule to be used. The station is operating on 1605KHz medium-wave, 6210KHz short wave and 104MHz with FM transmissions.

The program schedule is:

GMT	Language
0500-0900	German
0900-1600	International Service
1600-2400	English and German

The address for reports is Radio North Sea International, P.O. Box 113, Zurich 8047, Switzerland.

XERMX VERIFIES.

Radio Mexico, which has been reported in recent issues as being heard on a test transmission, has acknowledged our reception with the promised souvenirs. This came in the form of a record album with two LP records, a 45 r.p.m. disc, and a book about Mexico. The address on the registered parcel was Radio Mexico, Apartado Postal 20100, Mexico 20, D.F. Mexico.

The station continues to be heard, and we have now received their signals on three frequencies: 11720, 9535 and 6055KHz. The test transmissions of light music can be heard to sign off at 0600GMT and the station frequently identifies in German, French, Spanish and English.

CYPRUS ON 9715KHz.

The Overseas Service of the Cyprus Broadcasting Corporation, at Nicosia, has made a frequency change, and is now operating in the 31-metre band on 9715KHz according to Bob Padula of Melbourne. This outlet has replaced 11910KHz, and is in use from 1900-2100GMT. On Sundays the transmission is on the air from 0900-1600GMT, on 17875KHz.

The station has provided fair reception from around 2030GMT with a program of Greek songs. Announcements were given in Greek and English at sign-off at 2100GMT.

After uninterrupted music a short announcement by a lady speaker in Greek precedes the closing announcement in English.

This anouncement indicates that transmissions are on the air from 1900GMT on 9715KHz in the 31-metre band.

FINLAND USING 11755KHz.

The Finnish Broadcasting Company has been received on the new frequency of 11755KHz.

This has replaced 11805KHz, which is no longer used.

Reception in New Zealand has been best for the period 0600-0630GMT when signals are fair with some sideband interference from B.B.C. London on 11705KHz. The other Finnish channel which is audible, 9550KHz, is blocked by Sofia Radio to 0625GMT. From this time onwards, announcements in Finnish, English and Swedish are given, before the station signs off. The complete program schedule is:

GMT	KHz
0600	9550, 11755, 15185
1000	9550, 11755, 15185
1200	9550, 11755, 15185
2000	9525, 1175, 15185

The frequency of 9525KHz replaces 9550KHz for the 2000GMT transmission only.

JAPAN COMMERCIAL RADIO.

The Nippon Short-Wave Broadcasting Company, in Tokyo, operates Japan's only commercial short-wave service. The company has 50KW transmitters located at Tokyo, operating on the following schedule:

GMT	KHz
2030-1600	3925, 6055, 9595
2030-2300	3945
0800-1600	3945

A second program, which is carried on 10KW transmitters at Sapporo, operates on the following schedule.

GMT	KHz
2300-0720	3945, 7230
0100-0500	9760

KUWAIT ON 15405KHz.

The Kuwait Broadcasting Service recently made a frequency change for its program beamed to Europe. The new frequency is 15405KHz. We are hearing the signal at fair strength and it has been noted with a news bulletin in English at 1830GMT. At 1845 there follows a music program, and the station leaves the air at 1900GMT. According to the closing announcement the program is beamed to Europe on this frequency, and the service continues on the medium-wave frequency of 1133KHz, and on 17750KHz, for listeners in the Gulf Area.

There is considerable sideband interference from two stations, the Voice of America, Greenville, on 15410KHz being the worst of the two.

ENGLISH FROM IRAN.

Radio Iran at Teheran has been heard at our listening post on two new frequencies for their English broadcasts at 2000GMT. The new channels are 7024 and 9020KHz. The old frequency of 11730KHz is still used. The External Service is on the air from 1925 to 2130 and has been heard on these three frequencies.

The Home Service of Radio Iran is giving very good reception on the new frequency of 15085KHz and has been heard from around 0600 to after 0930GMT. The Home Service is on this frequency to 1530GMT, and has also been observed on 12180KHz. The program is in Persian, and news is generally broadcast on the half hour.

THE VOICE OF VIETNAM

A schedule received from the Voice of Vietnam, 58 Quan Su Street, Hanoi, North Vietnam gives indication of their various foreign languages broadcasts and the operating frequencies. The best received English program is on 10040KHz but this is not included in the schedule.

All broadcasts are on 1240KHz on medium wave and on 7360, 7416, 9840, 10224, and 15018KHz. Broadcasts in English are at 0500, 1000, 1300, 1530, 2000, and 2300GMT.

French broadcasts are on 1240, 9840, 11840, and 15018KHz and are on the air at 0400, 1330, 1630, 1830 and 2030GMT.

Japanese broadcasts are on 1240, 7360, 9840, 11840, and 15018KHz with transmissions at 2130, 1230, 1430, and 1600GMT.

RADIO MALAYSIA

Present schedule of the external service from Kuala Lumpur, known as "The Voice of Malaysia," is given by the Japanese Short-Wave Club as follows:

GMT	Language
0625-0855	English
0900-1100	Indonesian
1105-1255	Chinese
1300-1700	Indonesian

All transmmissions are broadcast on 6175, 11900 and 15285KHz.

PAKISTAN VERIFICATION.

For many years Radio Pakistan has failed to include the frequency and date of reception on their verification cards. This type of information is of vital importance to the listener, when stations operate on many frequencies.

We were indeed surprised to receive recently from Radio Pakistan, Rawalpindi, a verification letter as well as a card which specifies the frequency and date of reception. The letter came from the Director of Listeners' Research and the reverse side of the old verification card now has provision for full verification details.

Radio Pakistan in their transmissions to the British Isles have recently been observed on 9465 and 7095KHz. The broadcast in English is on the air from 1945 to 2030GMT.

PHILIPPINES CHANGES

The South East Asia Radio Voice, in Manila, has continued to carry out test

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney 12 hours for Wellington.

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DC voltage:	0.3V 1.2V 3V 12V 30V 120V 300V 1.2kV 6kV 25kV (with probe)						
AC voltage:	6V 30V 120V 300V 1.2kV						
DC current:	60μA 3mA 30mA 300mA 12A (300mV)						
Resistance:	Range	×1	×100	×1K	×10K		
	Midscale	25Ω	2.5kΩ	25kΩ	250kΩ		
	Maximum	5kΩ	500kΩ	5MΩ	50MΩ		
Load current (LI):		60mA	600μA	60μA			
Load voltage (LV):		1.5V	1.5V	1.5V			
Volume lever:	−10∼+17∼+63dB						

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broadcasts on several new frequencies and plans to continue them for some months to come. At the moment the tests are as follows:

GMT	KHz	
0130-0230	15145	(English)
1300-1400	9750	(Chinese)
1400-1500	9750	(English)

Radio Veritas, in Manila, is also continuing its test transmissions and had recently added a test for listeners in Australia and New Zealand. This test broadcast is from 1100-1130GMT, and is carried on 11830 and 15170KHz. Reports are welcomed by Radio Veritas, P.O. Box 132 Manila. Reception reports to the South East Asia Radio Voice should be sent to P.O. Box 4148, Manila.

NEW ADDRESSES

According to one of our readers, Douglas Doull of Auckland, N.Z., the Deutsche Welle and Voice of Free China are now both using new addresses for reception reports and these are listed below.

The Voice of Germany,
5000 Koln 1,
Hohenzollernring 62,
Post fach 10 04 44,
German Federal Republic.

The Voice of Free China,
Overseas Department,
Broadcasting Corporation of China,
53, Sec 111, Jenai Road,
Taipei, Taiwan,
Republic of China.

RADIO NEW ZEALAND SCHEDULE

The present schedule of broadcasts of Radio New Zealand, Wellington, are as follows:

To The Pacific

GMT	KHz
1700-1815	6080
1700-1945	9755
1830-1945	11780
2000-2230	15110
2245-0545	15280
0600-0845	6080, 9540

To Australia

2000-0545	17770
0900-1145	11705, 9520

To Antarctica

0815-0845 (Sun) 9520

ENGLISH SERVICE EXTENDED

The O.R.T.F. in Paris now has an additional English program which is on the air form 2015 to 2100 GMT. This new service, called "African Magazine," includes news, comment, and music. Best reception is on 15295KHz, but other channels are heard with weaker signals carrying the program on 21580, 17720 and 15315KHz.

The English broadcast which is best received in the Pacific area is on the air at 0515GMT and best reception is on 11920KHz. Two other frequencies, 9700 and 11930KHz, have also been heard at the same time.

NEW SCHEDULES OPERATING

RADIO AUSTRIA'S INTERNATIONAL SERVICE

Austrian Radio, Vienna, has a schedule which covers all continents. Though the program is mainly in German, English sessions are being added, while identification in English is given each hour. The present times, frequencies and service areas are:

GMT	KHz	Area Served
0400-2305	6000	Europe
2000-2200	11925	Europe
1000-1200	9770	Europe
0400-0700	7245	Europe
1300-1500	11785	Europe and North Africa
0700-0900	7245	Europe
0500-1300	6155	Europe and North Africa
0900-1300	7245	Europe and North Africa
1300-1700	9770	Europe and North Africa
1500-1700	11785	Europe and North Africa
1700-2200	6155	Europe and North Africa
2000-2200	7180	Europe and North Africa
2300-0400	6155	North America
0000-0200	15145	Central America
2300-2400	9525	South America
0200-0400	11875	South America
1800-2100	15210	South America
0800-1000	17855	South Africa
1600-1800	17880	South Africa
1800-2000	15200	East Africa
0600-1000	15410	Middle East
1700-2000	9610	Middle East
0400-0600	17725	South East Asia
1400-1600	17780	South East Asia
1000-1200	17855	Australia, New Zealand
0600-0800	21670	East Asia
1200-1400	11870	East Asia

BROADCASTS FROM JORDAN

The latest schedule of the Hashemite Broadcasting Service, Amman, is now as follows:

GMT	KHz	KW	Language
0330-2300	800	200	Arabic
0330-0745	7155	100	Arabic
1730-2300	7155	100	Arabic
0930-1330	9530	100	Arabic
1345-1715	7155	7	Arabic
0330-2300	11810	5	Spanish-Arabic
2330-0030	15170	100	Spanish-Arabic
0955-1705	854	5	English
0955-1315	7155	7	English
1400-1705	9560	100	English
2015-2045	7155	100	English (Fri. Sat. Sun.)

ENGLISH PROGRAM RETIMED

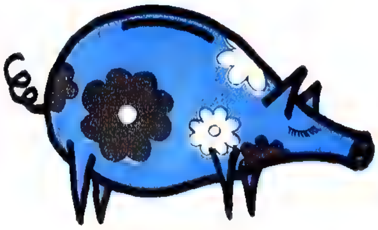
The Israel Broadcasting Authority, in Jerusalem, has retimed its services in English beamed to Europe and Africa. The new transmissions are 2045 to 2130GMT on 9625KHz. A service to Africa is on the air 2045-2100 on 9009KHz, and this same frequency is used to Europe 2115-2130GMT.

The service to Europe is on the air on 9009 and 9625KHz with Russian at 0400-0415GMT, and then from 1530 to 2230GMT the transmissions are carried in several European languages.

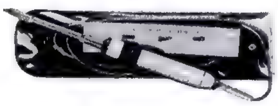
POWER INCREASES

In a recent broadcast of "Sweden Calling DXers," a summary of some of the

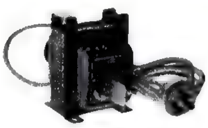
your money buys more



when you choose a SCOPE soldering iron



Both Irons are beautifully presented in a handy re-usable plastic pouch-pack, complete with one spare tip and two spare elements.



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ONLY 5 to 6 seconds' initial heating up time from cold, then practically instantaneous.

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Scope De Luxe weighs only 3½ ozs. complete. Miniscope 1¾

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Fully guaranteed with time tested dependability.

SAFETY
Low voltage operation. Heat sensitive components protected.

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Longer tip life. NO expensive heating elements to replace. Maintenance without special tools. Spare tips and elements readily available from your Scope Distributor.

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power increases scheduled to be put into operation this year was given.

All India Radio is expected to open its second million-watt medium-wave transmitter in a few weeks. This one is to be located at Rajkot and will be broadcasting programs to West Pakistan and greater India. The first million-watt transmitter at Calcutta was heard last October when it commenced to operate on 1130KHz.

Deutscherundfunk has increased its power from 20KW to 100KW and operates on 596KHz.

Mali is to have four short-wave transmitters installed each of which will have the output of 100KW.

Saudi Arabia has placed an order in France for eleven transmitters each of 100KW to be put into operation in that country.

Radio Cordac, in Burundi, plans to install a new 10KW transmitter in place of its present 2.5KW transmitter, which operates on 4895KHz.

O.R.T.F. in France has opened two new medium wave stations on Corsica. These transmitters will operate on 1178 and 1412KHz.

Israel Broadcasting Authority has announced that it will instal a 600KW short wave transmitter next year. Plans have also been announced for the installation of two 600KW medium wave transmitters, to come into service in 1972.

Radio Liberty, which has transmitters located in Germany, Portugal, Spain and Taiwan, is shortly to open a 1000KW transmitter in Spain. Radio Liberty broadcasts are directed to Eastern Europe and China.

The Portuguese relay station on Sao Tome is also to have a boost in power, according to a Radio Portugal broadcast. The Emisora Nacional relay is carried on a regional station on the island of Sao Tome. Later this year this will have 10KW medium-wave and 10KW short wave transmitters. Other transmitters are planned, to form a relay base for overseas broadcasts.

PREPARING FOR MUNICH

The 1972 Olympics at Munich in Germany will be heard world wide over new facilities now being built by Deutsche Welle, the Voice of Germany with studios at Cologne. The corner-stone was recently laid for this new station, according to a report in Radio Nederland DX Jukebox. Claimed to be the most powerful station in the West it will ultimately comprise 24 transmitters each of 500KW. The first step will be the installation of 12 transmitters with an aerial system of 74 arrays, designed to allow reception of the station in every part of the world. Nine of these antennas will be ready for use when the Olympic Games start in Munich in 1972.

THE BIG POWERS

The big powers in the political world, Britain, United States, Russia and China, are also the big powers in international broadcasting. A recent review of the position shows that they comprise the major short-wave broadcasters and occupy most of the short wave bands.

The United States has 96 short wave transmitters and eight medium wave stations some of which have the power of a 1000KW, and as well ten 250KW are under construction for short wave broadcasting. The B.B.C. in Britain and at its relay points has 62 short wave transmitters, some of 250KW, and has several medium-wave relays, including two of 750KW at Masharah. The exact number of short-wave transmitters in the Soviet Union is not known, but they operate from 72 different sites so there must be well over a hundred of them. Estimates give the Chinese People's Republic a figure close to that of the U.S.S.R. This means that these four countries operate over 350 short wave transmitters, enough to occupy 3500KHz frequency space alone, more than 1000KHz above the allocated short wave bands.

Happy Station Compere

Tom Meyer, the new compere of Radio Nederland's "Happy Station" program. Tom Meyer replaced Edward Starz recently, after his association with the program since its founding in 1928 ended with his retirement. The Happy Station is heard on Sunday at 0630GMT on 1170KHz and at 0800-GMT on 9715KHz.

AUSTRIAN ARMY RADIO

An interesting station is operated by the Austrian Army, and some information on its operation was published in a recent issue of "Contact."

The station has been operating irregularly since 1961 with a 10KW transmitter on 6255KHz. It now has a regular schedule and operates Mondays-Fridays from 1100-1230 and 1630-2000GMT. The programs are intended for the training and education of soldiers in the Austrian Army primarily. Every day, Morse code lessons for beginners and more experienced operators are broadcast, as well as talks about the army, lectures about citizenship, knowledge of Austria and similar matters. Music is broadcast, not only to break up the programs, but to enable the tonal quality of the receivers to be tested. The station's call signal consists of the first notes of the traditional song of the Austrian Army telegraph corps. The station is located at the barracks containing the Army's Telegraph School in the heart of Vienna.

Though the transmissions are intended for soldiers principally, many DX'ers, especially those in Austria and nearby German speaking areas, regularly listen to the programs and follow the Morse code classes. Reception reports have been received from 13 countries (East and West Germany, Sweden, Switzerland, Holland, Norway, Finland, Denmark, Belgium, Czechoslovakia, France, Austria and the United Kingdom). The station asks for reports from anyone who hears them, with a preference for short taped reports. The station verifies with an attractive red, white, and black QSL card with full details. International Reply Coupons are appreciated, but are not necessary to obtain a verification.

FLASHES FROM EVERYWHERE

ASIA

SEYCHELLES: According to a report in "Sweden Calling DXers," the Far East Broadcasting Association continued to test with a low-powered transmitter. There have been delays in the construction of FEBA's 40KW transmitter, but they hope to have this on the air shortly with broadcasts to the Indian subcontinent. The final stage of installation is a 250KW transmitter, but it may be 1972 before this is in use.

The test transmissions are scheduled as follows:

GMT	KHz
0030-0130	11755
0130-0330	15185
1500-1630	15185

TAIWAN: The Voice of Free China, at Taipeh, provides good reception at our location with its transmission in English to Africa and Europe. The best frequency is 15370KHz, and this one has been heard with English news at 1815GMT. At 1825 a music program is presented, and at 1845 a topical talk.

SOUTH VIETNAM: A new regional station of the VTVN network has been observed on 9670KHz. Our reception has been at 0945GMT when a Vietnamese program is broadcast, and at 1000 there follows a news bulletin in Vietnamese. Signal strength is weak, but improves after 1000GMT.

CEYLON: The Ceylon Broadcasting Corporation, Colombo, is now opening at 0100GMT says Bob Padula of Melbourne. The Commercial Service can be followed till after 0300GMT. A relay of the B.B.C. World Service News was given at 0200GMT.

BURMA: The Burma Broadcasting Service at Rangoon is well received with English at 1445GMT on 5040Hz according to Jack Fox, Mosgiel, N.Z. Information received from the station shows the full schedule as:

GMT	KHz
0030-0230	7120
0230-0430	6035
0430-0730	9685
1100-1600	5040

IRAN: Radio Teheran is reported in "Sweden Calling DXers" as being received on 7069KHz 24 hours a day in Farsi. The Home Service has been observed on 7045KHz at 0100 to 0800GMT. English is carried on 7044KHz from 2000 to 2030GMT with a program beamed to Europe. The same service is broadcast on 11715KHz.

(Continued on page 180)

NEPAL: A report from a listener in Ceylon states that Radio Nepal now opens one hour earlier for its morning and evening transmissions. The sign-on times are now 0120 and 1220GMT. The frequencies used are 7105 and 11970KHz at 0120GMT and 7165 and 11970KHz at 1220GMT. The power on 11970KHz is 100KW for the morning transmission, and 7165KHz has 100KW for the evening service. At other times power is 5KW.

TIMOR: Radio Timor, at Dili, is heard in this area on 3268KHz. The station is on the air to 1430GMT daily, except for Saturday, when sign-off is 1500GMT.

BROADCAST BAND NEWS

GILBERT AND ELLICE ISLAND: The new medium-wave station VSZ1 has been heard on 844KHz at good strength in New Zealand on its new power of 10KW. The station, which has also been reported by listeners in North America and Hawaii, is one of the most consistent signals from the Central Pacific area. The station in the past used very low power, but late last year a new medium-wave station was constructed at Bairiki Island, while the short wave transmitter which operates on 4912KHz with 2.5KW was moved to Betio. Radio Tarawa is on the air from 1845 to 2000GMT with English programs and also between 0700 and 0745GMT. Broadcasts in Ellice are from 0745 to 0830 and in Gilbertese from 0830 to 0920GMT. Signals in New Zealand have been fair with some interference from Masterton on 840KHz. On Mondays the broadcasts have been heard to as late as 1000GMT. During the Monday transmission a program of English lessons is heard at 0915.

The new high-power transmitter of Radio Tarawa was heard on its initial test broadcast by Robin Chambers, Opunake, N.Z. In a verification letter the station replied: "We were very pleased to receive your reception report on 844KHz for the 9th January, 1970. We verify that the details are correct. This report is particularly interesting as you were listening to the first transmitted programs of our new 10KW transmitter which was in service for the first time at 1830 on this evening. I am sorry that you will no longer be able to pick up our 50W transmitter. This is home-made and did very well, being in service of 10 years. I think we shall now put it to rest. We have also had good reception reports from Honolulu and British Solomon Islands. We shall continue to transmit also on our 2KW shortwave transmitter on 4912KHz, but if generally reception is better on medium wave we shall dispense with short wave. Our call sign has been changed to VSZ, VTW we found being already in use."

CEYLON: Three new transmitters on medium wave have been put into operation by the Ceylon Broadcasting Corporation, according to "Sweden Calling DXers." The first 50KW transmitter located at Maho is operating on 640KHz, while a second 50KW transmitter at Kandy is expected to use 635 or 645KHz. A third transmitter with the power of 10KW is also expected in service. These three units have been given to Ceylon by West Germany. Radio Ceylon is pleased to receive reception reports, which should be sent to: Deputy Director General, Ceylon Broadcasting Corporation, Independent Square, Colombo 7, Ceylon.

AUSTRALIA: The Western Australian station 6BS Busselton operated by the A.B.C. is now in service on 680KHz. Signals in New Zealand are good at sign off 1600GMT although the station is using only 2KW. The Perth Station 6WF has moved from 690 to 720KHz. The new station for Alice Springs has been assigned the call 8HA and will be operating with commercial programs.

ANSWERS TO CORRESPONDENTS

NOVICE LICENCES: It is nearly a year now since I wrote about the novice transmitting licence. Since then I have hardly heard a thing about it. I think that if the novice licence was introduced to the VKs it wouldn't be long before the Australian Amateur Bands were filled with more "Hams" and less people transmitting illegally. For several months now I have been studying for my A.O.C.P., but have had to give it up as I am now in my fourth year and have to study for my School Certificate. If this novice licence was brought into being I am sure that many Y.R.S. clubs would have several novice licences among them. Since I have written I have formed a radio club at our school and as yet we have no ham licence in the club, and so we cannot get on the air as a group. I am sure that there are many more Y.R.S. clubs in the same position and if novice licences were introduced this would not be so. **(D.S., Glenbrook, N.S.W.)**

● We have given the matter of novice licences a great deal of publicity in the past, so far to no avail. Your letter may stir things up once again.

RECEIVERS: I would like to know if you can print a circuit in "Electronics Australia" for a short-wave receiver which is cheap to build. Also, is it possible to print a circuit of a very high frequency receiver, capable of receiving satellites or space craft; e.g., would have been able to receive Apollo 11 or 12 while on the moon? **(R.D., Gordon, N.S.W.)**

● We have published a number of simple, economical receivers, the most recent being "A Simple 3-Band Receiver," published in June, 1967 (File No. 2/SW/41). Regarding a receiver for S-Band communications (above 2000MHz), such would be completely out of reach of practically everybody. Besides having a receiver which is extremely complicated in design (the RF amplification must be especially good) the antenna must be completely steerable in all directions for tracking. In short, you would need something approaching the size and specifications of a regular space station to do the job!

ABBREVIATIONS: Would you publish the enclosed circuit of a square wave adaptor in the "Reader Built It" section, please. Also, could you explain the following abbreviations: L.C.R., Vcbo, Vceo, Vebo, Ic, Vox and VFO. Further, could you provide the specifications of the following components: OAZ202, 2N3055, 2N33054, 0C201, and 0C76. **(R.H., Westbourne Park, S.A.).**

● Thank you for your contribution to "A Reader Built It," R.H., which has been filed. Out of context, we are not sure about the abbreviation L.C.R. It could be the three properties of inductance, capacitance and resistance. Alternatively, it could be an abbreviation for one device. Vcbo is the breakdown voltage between collector and base of a transistor with its emitter open circuit. Vceo is the breakdown voltage between collector and emitter with the base open. Vebo is the breakdown voltage between emitter and base with the collector open. Ic is collector current, or IC stands for integrated circuit. Vox means voice operated transmitter, and VFO variable frequency oscillator. The Information Service is not able to provide specifications for circuit components and devices. This information should be obtained from the manufacturers or from their data books. We suggest that you obtain a transistor data book.

TACHOMETER: Regarding the query of R.G., Brisbane, about a tachometer for a two-stroke scooter, I enclose a circuit which I have found suitable. **(T.R., Perth, W.A.)**

● Thank you for your trouble, T.R., and we have forwarded a copy of your letter on to R.G. We may also file your circuit for possible use in the "Reader Built It" section. Incidentally, we like all correspondents to give their full name and address, as evidence of good faith, even if this is not for publication.

SCRATCH AND RUMBLE: Can you provide me with circuits for stereo scratch and rumble filters, **(A.C., Lane Cove, N.S.W.)**

● There are practical problems which make it difficult to design "universal" rumble filters suitable for use with any amplifier, and while these difficulties could be overcome, the results would most likely be unattractive by virtue of the complication and cost of the construction. These filters are mainly only a practical proposition when designed as an integral part of the amplifier circuitry. Attempts to impose them as external additions to an existing amplifier can all too easily lead to disappointing results. The reasons why we have not become involved in so-called "scratch filters" are summed in up in the article "Scratch Filters — a Myth that Lingers On," published in "Audio Topics" in the September, 1969, issue. (File No. 8/AT/21).

CROSSOVERS: Could you possibly advise me on the use and construction of crossover systems for use in multiple speaker set-ups. **(R.H.S., Auckland, N.Z.)**

● Information on this subject is rather scattered. A description of cross-over networks was given in October, 1955 (File 1/SE/4). In October, 1963, we presented an article entitled "Adding Tweeters to Amplifiers" (File No 1/SE/12). As well as these, many of our loudspeaker enclosure articles have featured simple crossover networks.

TAPE ADAPTER: Compliments on a fine informative magazine. After reading a friend's copy of the September, 1967, issue and finding great interest in the 119 Tape Adapter, I wondered if there was any chance of you describing a solid-state unit with both high and low impedance inputs. **(P.M., Albury, N.S.W.)**

● We have not had occasion thus far to develop a solid-state version of our Tape Adapter, although some thought has been given to the idea. It may well be a possibility for a future project.

MURPHY'S LAW: I was very interested to read the corollaries to Murphy's Law which apply to electronics as, although

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W. 2001: 5/69

ANSWERS – continued

I have often met them in practice, I have never seen them in print before. I have compiled a list of the general corollaries to the Law. **(P.M.W., Myrtleford, Vic.)**

● Thank you for your list, P.M.W., but we feel that publishing too many rules and corollaries would labour the humour unduly.

WEAK 807s: The story about poor 807s ("Serviceman," February issue) came as no surprise to me. I had a similar experience, though in my case the 807s might have been "taking off," due to bad layout. I finished up changing the sockets and using a pair of 6BQ5s. They gave me all the power I needed. **(R.B., Bellevue Heights, S.A.)**

● In the Servicemen's case the trouble was purely and simply weak valves. Had there been any sign of instability, it would have been evident on the oscilloscope, which he said he used. In a badly laid out equipment, 807s certainly could be unstable but this would indicate that the valves tended to be good rather than bad. While the 6BQ5s fixed the trouble and saved further worry, you will presumably never know why the 807s were unsatisfactory.

MURPHY'S LAW AGAIN: The Murphy's Law segment in the February issue was most amusing, and I might add not solely confined to electronics. Having been a member of the R.A.A.F. for nearly eight years, I have seen Murphy's Law in action many times, but have not heard the Law quoted outside service circles. Murphy's Law in the R.A.A.F. is expressed as: If an aircraft part can be installed incorrectly, someone will install it that way. Some instances are:

An installation calling for a high tensile bolt and lock nut — made with an alloy bolt and castellated nut!

Right-hand engine throttle — connected to left-hand throttle lever in cockpit. This usually produces loud and uncouth noises from the pilot.

A phase of inverters — earthed instead of B phase, causing gauges to run backward. This produces noises similar to the above.

Landing gear sequencing microswitches cross-wired. This sometimes results in two wheels up and one down on an undercarriage check — a sight to behold.

Another good one is to cross one aileron wire so that they both work in the same direction. This is guaranteed to upset any pilot who happens to be watching.

The foregoing are only samples, but you can imagine the vast array of faults that could occur with different types of aircraft. **(M.B.I., Brassall, Qld.)**

● Thank you for an amusing account of Murphy's Law in action.

BUYING RECORDS: Would you be able to do a feature on how to purchase good quality recordings? There seems to be no classification as to the quality on the various labels. I have just purchased a hi-fi system involving parts as listed. (Here follows a list). Would you assess the compatibility of the above and tell me how it rates in terms of equipment currently available in Australia? **(H.I., Devonport, Tas.)**

● Record buyers do tend to generate preferences for particular labels, on the basis that they seem best to meet their overall needs in terms of titles, quality and price. In fact, however there is no sure way of picking quality by the label. It may be safe enough to assume that a recent performance by a named orchestra on an expensive label will be technically good but not everyone wants to buy at this level. At the cheaper prices one can find some top quality recordings and some quite mediocre ones. Our reviews aim to guide readers in respect to as many records as we can cover but we can cover only a small proportion of the total releases. If you want to build up a library of records as economically as possible, we can only suggest that you check through our reviews each month and look out for records which would appeal. We prefer to avoid questions about the merits of equipment and combinations of equipment. Apart from becoming involved as a third party in arguments, the simple fact is that we could not hope to be au fait with the details of everything that is currently on offer. Yours sounds like a good average hi-fi installation of the general standard that appeals to hi-fi enthusiasts. To do significantly better, you would have to se[e] equipment that was exotic in price, as [we]ll as performance.

Stylus overhang

I recently purchased a tone arm from a friend but he had no data on where to place it on the turntable base. I found formulas in a hi-fi textbook for working out the overhang and offset angle but neither of them worked. I would be pleased if you could work out the figures for my arm. Congratulations on a fine magazine. **(T.B., Mentone, Vic.)**

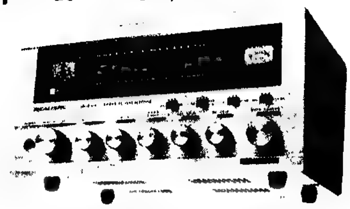
● Sorry but we cannot undertake specialised tasks of this nature through Information Service. Of sheer necessity we have to stick pretty closely by the conditions set out in the first "Answers" page in each issue. The formulae you were trying to use were probably intended for the design of an arm. Where you have an arm, a formula would be needed which provides for all the specifications of the arm and size of disc to be involved, leaving only the overhang to be found. We suggest that you tackle the mounting on a practical basis. Cut out a strip of card long enough to accommodate a radius equal to that of the disc. Punch a hole in one end to fit neatly over the spindle, and draw a line along the cardboard slip exactly through the centre of the hole. This line will form a movable radius. Mount the cartridge in the arm and see that the body of the cartridge is in line with the body of the arm or head adjacent to it. Now mount the arm temporarily in position — if need be on a scrap of board — allowing the stylus tip to overhang the spindle by about 3/8 inch. Now rest the stylus on the line of your movable radius at points above the inner and outer groove, and at intervening points. Sight vertically down on the head and see whether the line forms a right angle with the arm or shell. Increase or decrease the amount of overhang and repeat the observation, noting whether the range of mistracking appears to increase or decrease. Choose a position which distributes the error more or less equally to either side of optimum tracking. Tend to err a little on the side of reduced tracking error at the inner grooves, since these are the ones where tracking error is least desirable. Having thus determined a figure for the distance between the spindle and pickup arm pivot, you can mount the arm anywhere on the board which satisfies this distance and which allows clearance to operate the arm.

HAM RADIO SUPPLIERS Mail Order Specialists

323 ELIZABETH STREET,
(2 Doors from Little Lonsdale Street)
MELBOURNE, VIC. 3000
TELEPHONES: 677329, 674286

7 WATT SOLID STATE STEREO AMPLIFIER
10 Transistor, 3.5 Watts per channel, Crystal/Ceramic input (250mV), Frequency Response 50-20,000 c/s, 8 and 16 ohms output, polished wood case, metal front panel. Dimensions: 8½in x 3in x 5 3/8in.

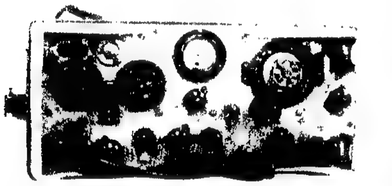
Special Price $34.50. Post 75c



REALISTIC DX-150 SOLID STATE COMMUNICATION RECEIVER

Features:
240V A.C. or 12V D.C. operation.
30 Transistors and Diodes.
535 Kc. to 30 Mc. in 4 Bands.
Bandspread tuning, "S" Meter, AM/CW/SSB. Product Detector for SSB. Compact size 14 1/8in x 9¼in x 6½in. Polished metal panel, small internal speaker.

F.O.R. PRICE: $229.50
Matching external speaker $13.30 extra.



No. 62 TRANSCEIVERS. Wireless set No. 62 Mk.2 (PYE) Frequency Range 1.6 to 10 McS, in 2 bands, inbuilt 12-volt Genemotor Power Supply. Clean condition. Fully air tested on Transmit and Receive.

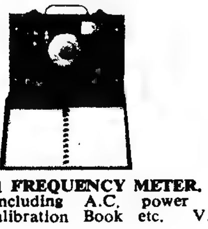
F.O.R. PRICE: $49.50

WESTON LM-330 MOBILE TAXI RADIO. Low Band A.M., 60 Kc. Bandwidth, 70-80 Mc. Crystal Channel Locked, Single Channel, Inbuilt Transistor Power Supply, 12-volt operation, suit country taxi service or conversion to Ham Bands, inc. microphone and cradle.
AS NEW AND AIR TESTED.

F.O.R. PRICE: $45. Packing 50c

LAFAYETTE *5 WATT C.B. TWO-WAY RADIO
MODEL HE-20. FULLY TRANSISTORISED, SOLID STATE, 13 Transistors, 10 Diodes, 27.240 Mc. Provision for 23 channels, CRYSTAL channel locked, Push-pull Audio Modulator, 455 Kc. mechanical filter, spotting switch for accurate reception, TVI Trap, 230V A.C. and 12 Volt (positive or negative ground). Inbuilt P.A. Amplifier. IDEAL FOR FIXED BASE STATION OR EMERGENCY MOBILE, including microphone and mobile cradle.
* Subject to P.M.G. approved licence.

F.O.R. Price: $169.50. Tax Paid
Fibreglass Helical Aerial 4ft high, cowl mount, for mobile use $16.50 extra.



BENDIX BC-221 FREQUENCY METER, 125Kc. to 20 Mc. including A.C. power supply. CRYSTALS, Calibration Book etc. V. clean condition.

F.O.R. Price: $49.50. P'ckg. 75c

MODEL C-1000 POCKET MULTIMETER, 1000 ohms/per Volt. AC Volts: 0-10/50/250/1000 (1000 opv). DC Volts: 0-10/50/250/1000 (1000 opv), DC Current: 0-100mA Resistance: 0-150K ohms (3K centre). 2 colour scale. Range Selector Switch. Dimens.: 3½ x 2¼ x 1in.

PRICE: $6.50 post free

MODEL 200H MULTIMETER, 20,000 opv. DC Volts: 0-5/25/50/250/500/2500V (20,000 opv) AC Volts: 0-15/50/100/500/1000V (10,000 opv) DC/Amps: 50uA/2.5mA/250mA. Resistance: 0-60K/6M ohm (scale centre 300 ohm—30K ohm. Capacitance: 10uuf to .001uF/.001uF — .1uF, D3 scale 20 db to plus 22 db. Size 4½ x 3¼ x 1 1-8.

PRICE: $11.25 post 30c.

MODEL CT330 MULTIMETER, 20,000/OPV. DC Volts. 0-6/6/30/120/600/1.2K/3K/6K Volts, AC Volts: 0/6/30/120/600/1.2K Volts (10K/OPV), DC/Amps: (0-0.06mA/60mA/600mA. RESISTANCE: 0-6K/600K/6M/60M/600Megohm. (30/3K/30K/300K ohms) centre scale: Capacitance: 50 uf to .01 uf .001 to 0.2 uf. Decibels: —20 to plus 63db size approx. 5½ x 3 5/8 x 1¾.

PRICE: $16.75 post 30c.

MODEL OL-64D MULTIMETER, 20,000/OPV, DC Volts: 0-0.25/1/10/50/250/500/1000V at 20K/OPV, 5000 volts at 10K/OPV, AC Volts: 0-10/50/250/1000V at 8K/OPV, DC/A: 50uA/1mA/50mA/500mA/10 amps. RESISTANCE: 0-4K/400K/4M/40Megohm. DB Scale: —20 to plus 36db. Capacitance: 250pF to .02uF. Induct. 0-5000H. size 5¾ x 4 1/8 x 1¾in.

PRICE: $19.50 post 30c.

NEW MODEL US-100. Overload protection. Shockproof Movement, polity switch. DC volts: 0.25/1/25/10/50/250/1000V (20K/OPV AC Volts: 0-2.5, 10/50/250/1000V (5K/OPV), DC/Amps: 1mA/25mA/500mA and 10A. AC/Amps 10A. RESISTANCE: 0-50M/ohms (centre scale 50) R X 1/10/100/1K/10K, db scale —20 to plus 10 plus 22/plus 35/plus 50 db.

PRICE: $28.75 post 40c.

Mirror Scale

MODEL AS100/DP HIGH SENSITIVITY
100,000/ohms/volt DC, Mirror Scale, PROTECTED MOVEMENT, SPECIFICATIONS: 6/20/120/300/600/1200 Volts A.C. (10K/OPV), Volts D.C.: 3/12/60/120/300/600/1200 (100K/OPV) D.C. Amps: 12uA/6mA/60mA/300mA/12 Amps., RESISTANCE: 2K/200K/20Mg/200Meg. Decibels: —20 to plus 63db. AUDIO OUTPUT: 6 Volts/30/120/300/600/1200V A.C., Size: 7½in x 5½in x 2¾in.

PRICE: $34.50. Post 75c

MODEL A10/P, GIANT (6½-inch), METER, CIRCUIT TESTER 30,000/OPV D.C. with inbuilt signal injector, overload protected, Specifications: A.C. Volts: 2.5/10/50/250/500/1,000 (10,000/OPV). D.C. Volts: 0.5 Volts/2.5/10/50/250/500/1000 at 30,000/OPV, 5000V at 10,000/OPV, D.C. Current: 50uA/1mA/50mA./500mA./1 Amp/10 Amp/A.C. Current: 1 Amp/10 Amp. Resistance: 10K/100K/1 Megohm/100 Megohm. SIGNAL INJECTOR: Blocking Oscillator circuit with a 2SA102 Trans. DECIBELS: —20 to plus 63db. SIZE: 6½in x 7¼in x 3¾in.

PRICE: $55 Tax Paid. Post 75c

TE-16A TRANSISTORISED TEST OSCILLATOR. Freq. Range: 400Kc. to 30MC. in 5 bands. Modulated: 800 c/s sine wave. Modulation: 30 p.c. approx. Output Imp.: Low impedance. Dimensions: 5 7/8in x 5 7/8in x 3 5/8in. Weight, 1.5lb.

PRICE: $23.75. Tax Paid. Post 75c.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 550 Kc/s to 30 Mc/s, continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ● ANL ● Variable BFC ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1.5 W ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 x 15 x 10in. With instruction manual and service data.

PRICE $175 inc. Sales Tax.
Speaker to suit type SP5D inc. tax.

02S Large Rubber Earpiece. 20-12,000 c/s (as per photo). **$6.75**

03S As above. Larger earphone. 20-18,000 c/s. **$9.25**

04S Deluxe model Individual Tweeter and Woofer control. **$12.95**

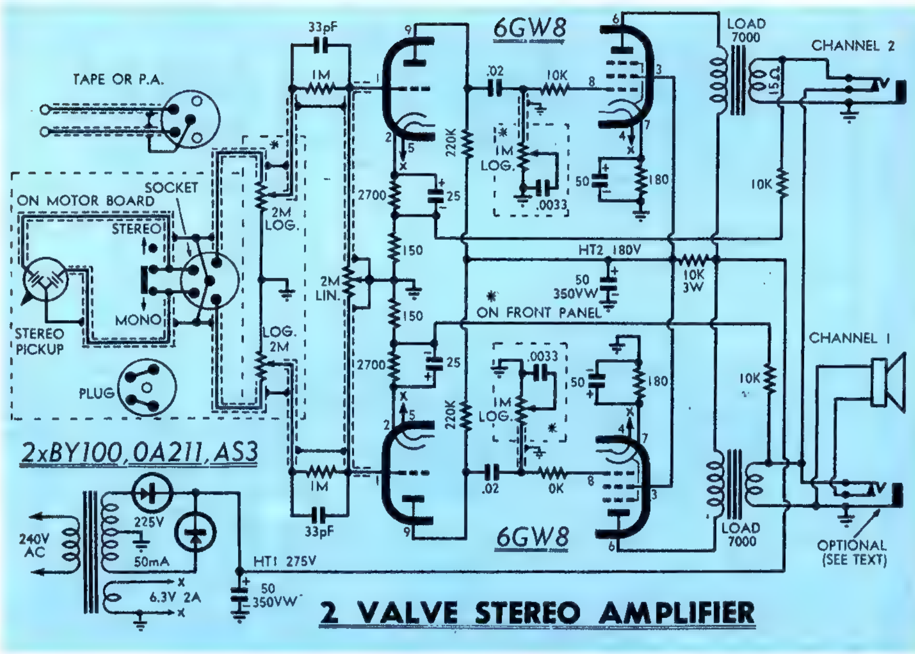
"NIKKA" 1 WATT TRANSCEIVERS

P.M.G. APPROVED. SOLID STATE 14 Transistor Circuit inc. R.F. Stage.
27.240 Mc (Provision for 2 Channels).
Range Boost Circuit.
Up to 10 miles in open country or water.
Buzzer Type Call System.
Squelch Control.
Complete with leather carrying case.

$165.00 PAIR

ANSWERS — continued

This handy little amplifier was described in the May, 1964, issue. Built up on a small, narrow chassis measuring 9½ x 2¾ x 1 inch, it was intended to tuck into any available space in a portable stereo player. The gain is ample to operate with crystal or higher-output ceramic cartridges and the power output of approximately 2 watts RMS per channel is ample for restricted living areas, flats, etc. In fact, the sound level available and the quality is largely governed by the nature of the loudspeakers used. As shown, both channels feed a common loudspeaker in mono mode. By using the appropriate jack, the output can be diverted to one larger external loudspeaker. Alternatively, the top channel can feed an external loudspeaker, providing stereo in conjunction with the inbuilt loudspeaker. Copies of the original article are available for 20c. Address your letter to: The Assistant Editor, "Electronics Australia," Box 2728, G.P.O., Sydney, 2001. Quote file number 1/SA/20.



RADIO CLUB: My friend and I have often wondered about having a radio club in Cootamundra, but we have no finance to back it. If you could help us, please do. **(David Parsons, 49 Murray Street, Cootamundra, 2590)**

● We could not undertake to provide finance for radio clubs but, in any case, this is not how they work. Interested hobbyists have to get together on a local basis, as often as not forming around a nucleus in a school, church, Scout group, etc. At least one technically competent and interested adult will be necessary, such as a teacher, radio/TV serviceman, licensed amateur, etc. We have published your name and address so that anyone interested in getting together with you can do so.

GARAGE DOORS: Over the years, I've enjoyed reading your magazine, with its wealth of information. However, I am still looking for a tested circuit for the radio control of garage doors. It should be possible to come up with something that would make the commercial price of $300 upwards of radio-equipped garage doors look silly. **(J.T., Wahroonga, N.S.W.)**

● We are gradually getting around to radio control equipment that could be used for a variety of purposes. However, we have thus far had to draw the line at getting involved in the controlled mechanism, whether it be a model or a door opening system. What you must bear in mind is that, given the radio link, the constructor still has a lot of work to do building the model or working out the door drive system, as the case may be.

COLOUR TELEVISION: A card in my letterbox advertising a set of books suggests that colour television is a 1928 invention. I'll settle for crude black and white TV at this time, but not colour. **(J.C., Harbord, N.S.W.)**

● Without getting out our television history books, 1928 wouldn't be far from the mark. The fact was that early experimenters with crude mechanical scanning systems quickly realised that colour images could be obtained simply by using matching filters in their scan and reproduce systems. Colour flicker would have been terrible, of course, unless it was offset by speeding things up so that each colour separately produced definition comparable with the original monochrome reproduction. But modern colour television is as far removed from those early efforts as modern monochrome TV is from its origins.

ION RESTORATION: Technical Press articles have referred to devices that restore the natural surplus of negative ions in the air which, I believe, is upset by the presence of strong man-made electric fields, usually in populated environments. Benefits claimed for such devices include a refreshing effect on mind and body, as well as relief in the case of many respiratory disorders. Have you reviewed the Leak Sandwich loudspeaker? Please schedule a review of the Philips 202 turntable, which features electronic speed control. This is one section of your magazine that I always enjoy. **(C.M., Clayfield, Qld.)**

● We've seen occasional reference to ion depletion and restoration but in terms that didn't make much sense electronically. Before even thinking about the possibility of making such a device, we would want to see a technically accurate article which explained clearly how the human environment depleted ions, how this reacted on the human body and how the ion population could be effectively restored! We wonder whether some of the devices you have heard about are really electrostatic air cleaners — a very different and perfectly logical application for electronics. We reviewed the Leak Sandwich loudspeaker in the May, 1962, issue, when it first appeared on the market. One would fairly have to ask whether that review still applies or whether the loudspeaker benefited in the meantime from refinements. We do not schedule reviews in the way that we might do if we were primarily a product-oriented magazine, with equipment reviews as our main technical activity. For the most part, we review equipment as submitted by advertisers, and at the rate which time and space permits. We try to make the reviews informative in a general way so that they have something to say to the reader who merely wants to learn something about the particular class of equipment.

IGNITION SYSTEMS: Could you send me some particulars of capacitor discharge and transistor ignition systems. Can you tell me which month and year you featured circuits, and how to obtain a copy of these circuits. **(J.T., Alderly, Qld.)**

● We published an introductory article on capacitor discharge ignition systems in November, 1969 (File No. 8/DT/30). The only constructional details of such a system was published in our "Reader Built It" section in September, 1969 (File No. 3/TI/4). In common with all circuits published in this section, the circuit was not tested in our laboratories and we can offer no further assistance or information on it. We published a series of articles on transistor ignition in January to April and June, 1964 (File Nos. 3/TI/1-3). Copies of the articles are available through the Information Service for 20c each.

SOUND PROJECTORS

Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $90.00

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each
Post 10 cents.

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder. **$1.85**
Post.: N.S.W. 30c; Interstate: 40c.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$23.00

(2 TELEPHONE SETS)
30c cartage to rail. Freight payable at nearest attended railway station.

Please note we are now able to include ½ mile of telephone cable FREE with each set of Phones.

BATTERY CHARGERS

240 volt A.C. Input.
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp. without meter, $13.75
2 amp. with meter, $15.75
Post N S.W. 70c; Interstate 95c.

MINIATURE ELECTRIC MOTORS

1½ to 3 volts D.C Ideal for model boats, cars, planes, etc. Strong torque. Only 65 cents each or 10 for $4.00. (Post 7c).

TRANSCEIVER

(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones $45, 60c cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike $60. 60c cartage to rail. Freight payable at nearest attended Railway Station.

HEAD PHONES

Low impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair. Same with black felt muffler, $4.50 pair.
Post N.S.W 25c; Interstate 30c.

COLLINS TRANSCEIVERS

Auto-tuned 100-150 megacycles, 10 channels .. ..

$65.00

16'6" WHIP AERIALS

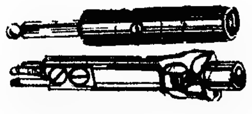
6-Piece, brand new, $5.75. 60c cartage to rail. Freight payable at nearest attended railway station.

AVO MULTI METER

Type CT 38
$75.00

A.W.A. AUSTRALPHONE

Transceivers 12 V
New Complete Station.
1.6 to 10 megs on transmit.
0.54 to 16 megs on receive.
$150.00



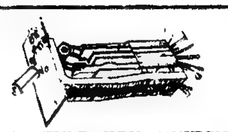
P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 1in 4 AH.
$1.00 each
Post, N.S.W., 25c; interstate 35c.

WALKIE TALKIE TWO-WAY RADIOS

P.M.G Approved Citizen Band. 9 Transistor, $79.00 per set of 2. Post, N.S.W. 50c; interstate, 60c.



P.M.G. TYPE KEY SWITCHES. 45c each. Post, 15c.

BC 221

Frequency Metres
$55.00

VALVES
BRAND NEW
IN CARTONS

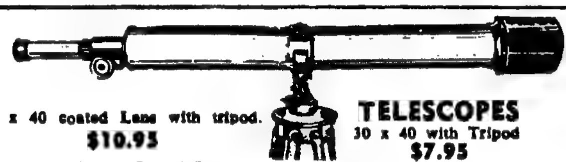
Special discount for quantity

807	75c	X61M	$2.20
6SN7GT	95c	CV850	$1.50
8989	$1.00	1H6G	30c
5U4G	95c	832	$5.00
77	$1.00	6AK5	$1.50
EF50	35c	6X4	$1.00
6U7	75c	12SK7	80c
5Y3	$1.75	VR65	25c
6C4	80c	VT4C	75c
2 x 2	75c	AU5	$1.00
6AG5	80c	80	$1.25
12AU7	$1.00	6AK5W	$1.60

CATHODE RAY TUBES

3FP7	$2.95	5BP1	$3.60
3JP1	$2.95		
V1669 4/1	$2.95	CY2184	$2.95

PLEASE ADD POSTAGE ON ALL ARTICLES



45 x 40 coated Lens with tripod.
$10.95

30 x 30 Power Coated Lens Brand new.
$3.75

60 magnification with a 60mm coated objective lens. With tripod.
$23.00

As illustrated.
Postage, 95c; Interstate $1.20.

TELESCOPES

30 x 40 with Tripod
$7.95
Post N.S.W., 70c; interstate $1.20

PETROL MOTOR GENERATOR SET

BRAND NEW EX-ARMY
300 watt, 15 volts, 20 amps. Made in Canada. Complete with tools, instruction book, spares, etc. Only **$75.00**

$1 cartage to rail, freight payable at nearest attended railway station.

HIGH STABILITY RESISTORS

I.R.C. brand new, usually 80c ea. 50 assorted values for only
$3.75
Post 15c.

RECEIVER 8C A.W.A.

With ABC and D Coils. Complete with all spares.
$90.00

ZOOM FOCUSING MICROSCOPE

Battery and mirror illuminated 900 x magnification, complete with dissecting kits, slides.
$14.50.
Postage N.S.W. 65c. Interstate 85c

TYPE S POWER SUPPLY

(240 Vac supply for AT 5-ARB) suit most types of Disposal transmitters and receivers outputs 250 volt, 10ma 550 volt 200ma, 300 volt 100ma, $30.00

TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile) $7 per coil.
Post, N.S.W. 70c; interstate $1.20.

SCOOP PURCHASE

Gramo Motors. New. Made in U.S.A. 4-speed 240 volt A.C. 50 cyc. Only $2.75 each.
Post, N.S.W. 30c; interstate, 40c.

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70 ohms 4 positions, can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9in x 8in x 8in $5.00 each. Post N.S.W 70c. Interstate $1.20.

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240 VAC with pick up Terminal. Used in good order Ex Studio.
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ANSWERS – continued

AILING RADIO: I own a transistor radio which stops every now and then. I find that when I make a series of short circuits, using a hang generator as the power source, the radio suddenly starts working again. (The short circuits are made near the back of the radio.) Could you tell me what causes this? **(B.Z., Corrimal, N.S.W.)**

● If you can explain to us what a "hang generator" is we may possibly be able to hazard a guess at what is going on.

MODEL TRAIN CONTROL: Has a circuit for a controlled 6V DC power supply for an electric train been published in "Electronics Australia"? If so, how can I obtain a copy of the circuit and what is the cost? **(R.G., Thirroul, N.S.W.)**

● We have published a number of model train control circuits which were designed for use with a 12V power source, but which could be used without modification with a lower voltage supply. The simplest of these appeared in February, 1967 (File No. 2/MC/2), followed by a version with simulated inertia in March, 1967 (File No. 2/MC/3). Copies of the circuits may be obtained through the Information Service for 20c each. How to apply for circuits is covered in the panel on the first page of this section.

YOUNG LISTENER: I am 14 years old and read your magazine each month. I find it very interesting. I have a three-band receiver that has a directional aerial. It can pick up stations on medium wave, but not a sound from the long wave or VHF. Can you give me a reason why? I have a 100-foot aerial attached from a tree to a pole. Can I connect it to my receiver in any way? I find your section "Listening Around the World" very helpful when I listen to my short-wave radio. I would like to report a broadcast of English from the Republic of South Africa at 1100GMT on 11MHz which includes the news. **(D.H., Morley, W.A.)**

● One possible reason for you not hearing anything on long waves is that there is very little to hear on this band in this country. Under certain atmospheric conditions, you may occasionally pick up an overseas station, but the necessary atmospheric conditions are rather unpredictable, and favourable conditions usually do not last very long. The VHF band is used for telecommunications (shipping, aircraft, police, taxis, etc.). If you can hear nothing, the set may not be operating properly. To couple your outside aerial to your receiver, twist a few turns of a lead-in wire round your complete set or round the internal aerial if you can get at it conveniently. The wire should then run to a good earth. Reports of stations heard should be sent directly to our short-wave correspondent, Mr Arthur Cushen, in New Zealand. However, on this occasion, we have published it for the convenience of other readers.

MOOG SYNTHESISER. Would you consider publishing an article describing the operation of the Moog Synthesister, as I am sure this would interest many readers. Also, have you described a circuit for a speech compressor? **(H.B., Mona Vale, N.S.W.)**

● By the sheerest chance, an article on speech compression was ready for publication when your letter arrived, and was published last month. Even more surprising, an article on the Moog Synthesiser was in course of preparation and appears in this issue. We note you refer to a "circuit" for speech compression, presumably with the idea of making one yourself. As the article explains, compression is achieved purely by mechanical means.

TRANSFORMERS: Is there any method of telling the type and the windings of transformers and if so, could you inform me where it may be obtained. I have gained much information through "Electronics Australia" and I hope I will continue to do so. **(A.S., Ryde, N.S.W.)**

● The only reliable method of checking a transformer's specifications is to consult the manufacturer's catalogue, assuming that the transformer in question is a locally made unit and the type number is legible. Manufacturers are usually only too happy to provide information on their products when requested. If the type number is illegible, or the brand unknown, it is almost impossible by simple means to determine the characteristics or even, for that matter, to say whether it is an audio, power or pulse transformer. Simple DC resistance measurement can do no more than indicate continuity of windings but give no clue to tappings, turns or impedance ratios or operating voltages. Unfortunately, even wiring colour codes appear to vary between manufacturers and these cannot be used with certainty to identify windings.

Printed boards

I am interested in building your Playmaster 127 Control Unit and Playmaster 128 Stereo Amplifier. However, I am unsure how to procure the printed wiring boards, as nothing other than their code number is mentioned in the articles. Can I obtain negatives or actual size drawings? Alternatively, where can the boards be bought? (D.T. Woodville North, S.A.)

● A lot of readers seem to be similarly confused, D.T., so we will state the situation in some detail. (1) These boards should be treated exactly as you would treat any other component in the parts list; simply order them from your normal supplier. (We distribute copies of the pattern to several board manufacturers, who make them in quantity for the trade). (2) If your regular supplier is unwilling to obtain them for you, there are a number of advertisers in the magazine to whom you can write direct. (3) If this is not practical, or you are keen to make your own, you can obtain exact size positive reproductions, on a stable base, through our information service for 50c each. (4) We do NOT deal in complete boards (or any other components) for any of our projects.

TUNER RESPONSE: I would like to know the relationship between the audio frequency range received by a tuner and its bandwidth, usually stated between the 6dB points. For example, what audio frequencies would be received by a tuner with a 10KHz bandwidth? What frequency is a whistle filter supposed to suppress? **(J.S.B., George Town, Tas.)**

● The bandwidth occupied by an AM broadcast station is twice the highest audio frequency modulating the transmitter. In the modulation process both modulating and carrier sum and difference frequencies are produced, forming the upper and lower sidebands of an AM transmission. Consequently, a station having an upper audio limit of, say, 5KHz, would radiate a signal 10KHz wide. If the full 5KHz modulation is to be recovered in the receiver, the receiver must in turn be capable of passing the complete 10KHz width of the transmitted signal. A receiver or tuner having an 8KHz bandwidth would attenuate the signal between 4 and 5KHz, passing without attentuation only those sideband components up to 4KHz either side of the receiver carrier.

Tuners designed for high fidelity reception usually have a bandwidth as wide as 20KHz. As broadcast stations in Australia are normally allocated with a 10KHz channel spacing, a wideband tuner is able to respond to the 10KHz heterodyne or beat note generated by two adjacent carriers being received simultaneously. To eliminate this annoying "whistle" an audio filter, tuned to 10KHz, is often employed after the detector stage.

ANSWERS – continued

HOW PROJECTS GROW: It should be possible to provide an interesting article—about articles! It could start from the method you use to decide what projects to attack. How you choose a particular configuration, decide on components, finalise the circuit. What part the prototype plays in all this. Perhaps it could be woven around a particular project and some of the maths could be worked in, which were involved in the design. Are you considering the description of another full calibrated oscilloscope within the next 12 months? **(N.K., Toowoomba, Qld.)**

● We'll keep your suggestion in mind. However, we can say this much; Ideas about projects come from a variety of sources in a variety of ways. Sometimes they start with the release of some key component. Sometimes the reverse happens —the idea has to await parts, which may become available tardily or not at all. We have to match out judgment of likely cost against the people who would be prepared to tackle particular projects, and also the situation in regard to competitive commercial items. So we could go on. We have no immediate plans to describe another calibrated oscilloscope. Before becoming involved, we would have to apply one of the above ideas: Examine the commercial market and see whether a home-made oscilloscope would have a clear price advantage over commercial instruments of similar specifications. If it didn't, much of the justification for proceeding would be gone. To be sure, a certain number of constructors would proceed, anyway, for the experience and satisfaction of building their own; plenty of others would just as soon buy and use, rather than build. Firms which get involved in the supply of metalwork, kits, etc., can't afford to be too sympathetic to motives. Primarily they are concerned about how many are going to buy bits, reasons apart!

CORRESPONDENCE COURSES: I wish to start a correspondence course in radio engineering and servicing to complement my interest in hi-fi stereo. I would appreciate any help you can give me regarding your preference of the courses available in this country. **(D.S., Fulham, S.A.)**

● We have no preference, and even if we had we would not be in a position to publish it. We can only suggest that you write to one or more of the firms that offer correspondence courses through our advertising pages, and then make your own choice.

MONO AMPLIFIER: Have you a circuit for a push-pull mono amplifier of about 10-15W output, using 6BW6s as twin triode drivers/phase splitters. I think you published such a circuit about 1955. The rectifier is a 5Z4 and there is a 6AU6 (possibly as voltage amplifier) and a 12AU7. Is there perhaps a suitable tuner for use with it. I have the circuit for a tuner from the stereo radiogram of April, 1959. Most of it fits in, but there is another valve in it, an EF86. Is this a pre-amplifier? I made your pre-amplifier of October, 1965. With the gain of the main amplifier advanced about two-thirds, the signal becomes pulsating, i.e., beating. The value of R1 is 470K. Can you suggest anything to account for the trouble? I am using a magnetic cartridge (50K and 4mV) into the preamp, then into a former crystal cartridge amplifier. **(W.W.-L., Corio, Victoria.)**

● From a quick check through our records, we do not appear to have published a circuit using the valves you specify. We asume you meant to say the 6BW6 pentodes were used as push-pull output valves, and the 12AU7 twin triode as the phase splitter. Possibly the circuit you are referring to is the one described in the May, 1955, issue (File No. 1/MA/33), which had the 6AU6 as voltage amplifier followed by the 12AU7 phase splitter, but with two EL84s in push-pull as the output stage. The rectifier was a 5V4-G. An earlier circuit, in January, 1955, has a 6AU6 voltage amplifier, a single 6AU6 as a phase splitter, two 6BW6s in push-pull and a 5YR-GT as rectifier. (File No. 1/MA/3.) We can supply circuits of both items through the Information Service for the usual 20c fee. Note, however, we do not have reprint material available for the complete article. All we can offer if the complete article is required is photocopies of the pages for 20c per page, the cost being $1.40 for the January, 1955, article, and $1 for the May, 1955, article.

Since the EF86 was not included in the original circuit of the 1959 radiogram, we cannot comment on its use in the set you have. Presumably it was added by someone. By taking due care with connections and supply requirements any valve type Playmaster tuner can be adapted to any valve type Playmaster amplifier, so you can choose from the many we have published. However, from the point of view of obtaining parts, we suggest you consider one of the later types, such as the Playmaster 111 of October/November, 1965 (File No. 2/TY/22-23). Alternatively, the basic tuner made from oddment parts described in the July, 1968, issue may appeal (File No. 2/UT/26). Concerning your preamplifier, it seems fairly certain from the symptoms you describe that you are experiencing "motor boating" brought about by insufficient decoupling between the amplifier and the preamp. The answer is to use heavier decoupling, and you will need to experiment with values of components until you find a satisfactory arrangement.

ELECTRONIC FLASH: A friend and I both have use for a multi-head electronic flash for studio portrait work. We considered building the Electronic Flash, September-December, 1966, but discovered it operated of Ni-Cd cells with an appropriate charger. As we will have no reason to use the units outside the studio we would like to suggest that you consider a simplified circuit for mains operation only. **(J.A., Fairfield, Q'lnd.)**

● We have no immediate plans for an AC powered flash unit, J.A., although we will keep the idea in mind. A small, low voltage flash designed for mains operation was described in the May, 1954, issue and reprints are still available under File No. 3/EF/4.

COLOUR CODE: Would you please publish the colour code for resistors in the "Answers to Correspondents" section? **(C.A., Kensington, N.S.W.)**

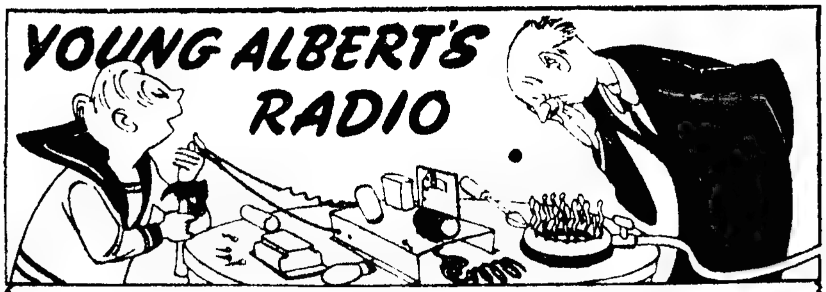
● We have published the colour code on several occasions, the latest being November, 1969. Copies of this article are available through the Information Service for 20c each. Please quote 8/LT/11.

BASIC ELECTRONICS: Could you give me some information on the price, availability and contents of the book "Basic Electronics" which you advertised some time ago. **(T.B., Bingara, N.S.W.)**

● "Basic Electronics" is the third revised edition of our own publication, previously known as the "Basic Radio Course" which was originally published in series form in the pages of our magazine. It is available through the Information Service for $2.20 including postage. A review of the book, giving the required information on contents, appeared in our March, 1969, issue. If required, photostats of the relevant page can be supplied for 20c, also through the Information Service.

SW RECEIVERS: As a DXer of many years I am most interested in all types of SW receivers Until recently I was all for valve sets as most transistor receivers tend to pick up QRM more freely. But now with quality transistor receivers on the market, I am wondering if a comparative report on some of these could be featured in a future issue. **(D. McR., South Perth, W.A.)**

● We are not likely to run direct comparisons of different makes as you suggest. Individual receivers might be reviewed if they are submitted to us for this purpose by our advertisers.



When Albert got et by a lion,
While prowlin' around at the zoo,
Said Mother: "Yon habit's unelthy,
Let's find him an interest new."

Next day, Albert's Pa at the station,
Saw radio books in a stack;
Said he: "Eh bar goom, that's idea,"
An fished in his pocket for a zac.

His son were suspicious of present,
But Pa said, "You'll like it, don't fret,"
And Albert soon got quite absorbed
In reading about one-valve set.

The editor bloke said: "It's corker,
Right fine for intelligent lad;
Loudspeaker an' all for a fiver,
Amount won't be missed by your dad."

When Albert broached subject to father,
His Pa felt quite feeble and weak,
But Ma said, "Don't hinder our Albert,
He'll pay it back, threepence a week."

So Albert went off to the parts store,
With "Hobbies" book tooked under coat,
Selected the bits and the pieces,
And paid for the lot with Dad's note.

Back home, he spread over the table
Queer things made of putty and wax,
Then hurried outside for some solder,
Screwdriver, a hammer an' tacks.

He heated the iron on gas ring,
Then laid it on paddin' of chair,
He drilled holes in best polished table,
And got sticky floox in 'is 'air

When Pa arrived home, tea weren't ready,
Said Ma, "Table's covered wi' joonk,
And Albert's got iron on gas ring,"
His Pa didn't say what he thunk.

At eight o'clock Pa said, "Young Albert,
It's time you were gettin' to bed,"
But Albert said: "Set's nearly finished . . .
Let's listen to music instead."

At nine Albert cried, "Job's completed,"
And hopped round the kitchen with glee,
His Ma 'eld 'er breath, quite excited,
And Pa put on glasses to see!

When Albert pressed brass startin' bootton,
Set gave out an ear-splitting howl,
His Ma stoombled back in the fender,
With loud cloockin noises . . . like fowl.

Said Pa, "Look, your Ma's had a seizure,
She's fainted all over the place."
And running back out of the kitchen,
Threw bucket of water in face.

But Albert kept fiddlin' with chassis,
And stuck pair of pliers in back,
Till soodenly sparks 'it the ceiling,
And out went the lights — all were black.

By midnight, when council fixed wyers,
On scene of destruction they coom,
Ma said, "Albert's made awful mook-opp,"
Pa said, "Ruddy like atom bomb."

Poor Pa he were pale and dejected,
He thought of his quids, crisp and new,
"Here's stick with the 'orse's head 'andle,
Go back lad, and play at the zoo."

NOTES AND ERRATA

DWELL EXTENDER (February, 1970.). In the parts list, capacitors C1 and C2 are described as 2.2uF solid tantalum (Sprague 164D or similar.) We have been informed the Kemet J-Series solid tantalum capacitors Type K2R2J20KS are suitable for this application. These are manufactured in Australia and are available ex stock from Union Carbide Australia Ltd., G.P.O. Box 5322, Sydney, 2001.

FIXED TUNED LF CONVERTER (October, 1969, page 40). In this article we reproduced certain information in good faith, believing it to be correct, regarding voice transmission on NDB frequencies. However, voice transmission is not normally available at certain capitals. A new table showing those capitals at which voice transmissions are available on NDB frequencies is shown below, and it now includes Canberra.

AERODROME	FREQUENCY (KHz)	C1 (pF)	C2 (pF)
Adelaide, S.A.	362	680	120
Brisbane, Qld.	302	1000	100
Canberra, A.C.T.	263	1200	82
Melbourne, Vic.	218	1800	56
Sydney, N.S.W.	317	820	100

Twenty years ago, and more, the voice of Stanley Holloway was often heard on the radio, recounting, in his characteristic Lancashire dialect, the adventures of Albert Ramsbottom. This particular "adventure" was composed by our present Editor and published originally in our June, 1946, issue. It has been reprinted in various other journals but, if you haven't seen it before, it might be good for a smile.

PLAYMASTER 128 STEREO AMPLIFIER (January, 1970, page 60). A voltage at the junction of the 1K and 2.2K resistors is incorrectly shown as 54V. The correct voltage is 50V when the zener reference voltage is at 60V.

AUSTRALIAN BROADCAST STATIONS (January, 1970). The commercial station at Albany, W.A., on 780KHz has the call 6VA and not 6WA.

240 COMMUNICATIONS RECEIVER (January, 1970): The parts list should read, 12 100 ohms, 2 3.3K, 11 4.7K, 4 6.8K, 7 47K, 14 0.1uF 25V ceramic, 4 0.22uF 25V ceramic, 4 27pF NPO ceramic, 1 47pF NPO ceramic. Apart from a minor circuit error, corrected in February, the circuit is correct and should be followed where there may be any doubt.

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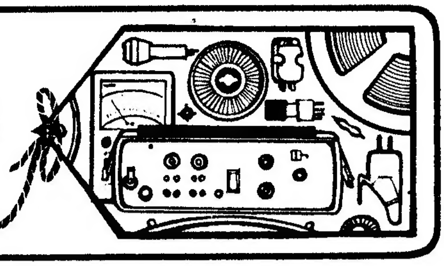

FOR SALE

FLASHOVER PROTECTION

(Cont. from p. 95)

dag itself. The effects produced by the discharge of this capacitance will therefore be increased.

For these reasons, it is preferable that the mounting frame be fixed to an insulating support; and, in order to prevent its potential from varying arbitrarily with leakage, connected to chassis or to the point M through a resistor of about 2 megohms. The insulating support and the resistor must be capable of withstanding a pulse voltage of the order of the EHT voltage without breaking down.

In a domestic television receiver, it is usually sufficient to fix the mounting frame to the wood or plastic front panel of the cabinet with the resistor connecting the frame to the point M. In industrial display equipment, however, where a metal cabinet is usually employed, the use of an insulating front panel on which to mount the tube is desirable. Alternatively, an insulating surround, of adequate dimensions, can be fitted.

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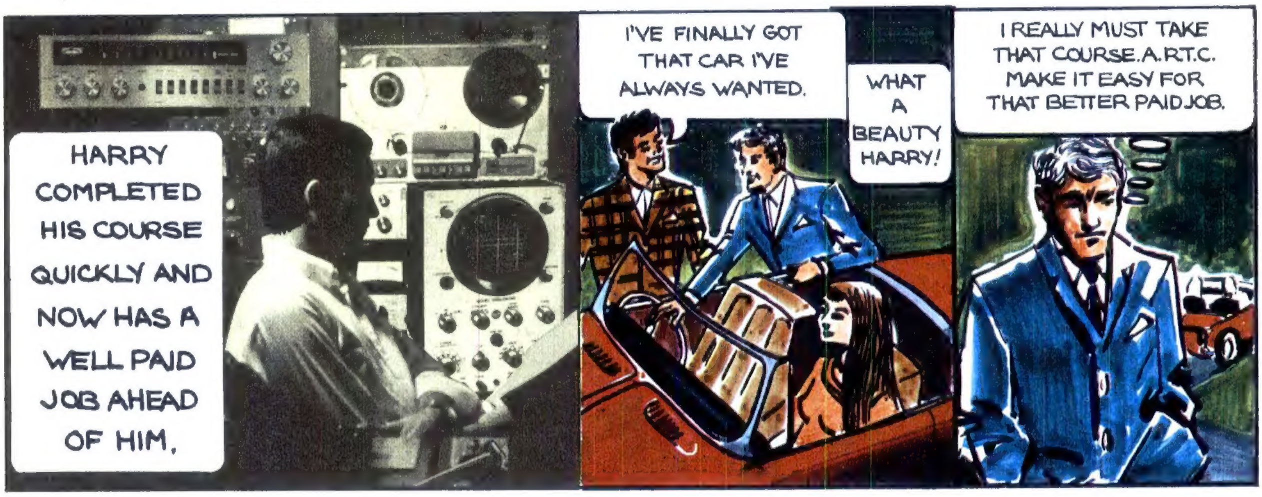

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